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DO GLACIERS EXCAVATE?*

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The publication of the late Sir A. Ramsay's paper on the Glacial Origin of certain Lakes in Switzerland,† full thirty years since, marks an epoch in the study of an important branch of physical geology. It dissipated sundry old-world fancies which still lingered, like the mountain mists, over the Alpine lakes, and propounded a hypothesis, which from its own plausibility and its author's scientific position and literary skill, attracted general attention. It was, however, opposed by Sir R. Murchison and Sir C. Lyell, and failed to win the allegiance of those members of the English Alpine Club, who cared for mountain physiography not less than for mountain climbing. In the ten years which followed the publication of this paper, four of the most experienced among these persons had expressed their dissent. The results of my own study of the question were given in a group of papers published between the years 1871 and 1877 inclusive Of these I shall avail myself this evening, though not without making full use of the more precise information which is now accessible, and of the opportunity for a somewhat different method of treatment. I adopt this course because, so far as I am aware, no advocate of Sir A. Ramsay's hypothesis has ever attempted to meet my objections by precise and definite statements, or has really added, except in one respect, to the arguments which the author originally advanced. New instances of the erosive action of glaciers are not unfrequently cited, but when regarded with a sceptical eye, they are only valid in the event of the original hypothesis being correct, that is to say, they depend upon instead of confirming it.

So since no one, so far as I know, has attempted the laborious task of following my footsteps in the Alps, and combating the difficulties which I have raised, by detailed discussion instead of vague generalities, I shall adhere very nearly to the old lines of attack, taking most of my

* Paper read at the Meeting of the Royal Geographical Society, March 27th, 1893.
† *Quart. Jour. Geol. Soc.*, vol. xviii., p. 185.

instances from the Alps, though other glaciated regions are not unknown to me, because that mountain chain is sure to be familiar to my audience, and is the one which I know the best.

It may be well to call attention at the outset to the fact that lakes—as all admit—may be formed in various ways. After the removal of subterranean masses of soluble salts, the surface of the ground may subside, and the local lowering of the bed of a stream may cause its waters to overflow and form a mere. This often happens in Cheshire and Worcestershire, owing to the extensive pumping of brine. Such lakes, however, are usually small, and, so far as I know, are always shallow. Again, a stream may be blocked either by a berg-fall, or by the terminal moraine of a glacier, or even by the drift which a tributary has swept down. The first of these produced the Lago d'Alleghe: the second the Mattmark See: by the third the level of many Alpine lakes, whatever be their origin, has been raised. Of the lakes, however, which actually occupy rock-basins, not a few are contained in old craters; doubtless, most of these are comparatively small; still some are not; for instance, the Lago de Bolsena, the area of which is only exceeded by that of the largest Alpine lakes. As regards these, the level of their waters, at least in several instances, is raised by masses of drift, brought down from other drainage areas by important tributaries, which has obstructed the course of the main river.* This, however, is a detail. I admit that most, if not all the great Alpine lakes, as well as the tiny tarns high up in the mountain fastnesses, occupy true rock basins, which in the case of the former, as well as in that of the latter, are attributed by the school of Ramsay to the erosive action of glaciers.

The paper, already mentioned, began with a discussion of certain earlier hypotheses, in the course of which it was proved, conclusively as I think, that the rock-basins of the Alpine lakes could not have been produced by any kind of local subsidence, or by fissures in the Earth's crust or by the erosive action of the rivers themselves. It was pointed out that they were abundant in regions which had been formerly occupied by glaciers, and it was urged that ice could erode and scoop. So, as no other hypothesis remained as a competitor, its advocates claimed a verdict in its favour.

Two weak points in this argument at once suggest themselves to careful and somewhat sceptical readers of Sir A. Ramsay's paper. The first one, why the lakes are so few and occur so low down in the valleys, is indeed noticed, but is met only by two or three vague generalities of little argumentative value. The second, and more grave one, is that a mode

* Thus the first outcrop of solid rock in the bed of the Rhone to the east of Geneva is about 34 feet below the level of that lake, and in the bed of the Rhine, so far as I know, about 25 feet below the level of Constance. It must be remembered that a lake once formed regulates the velocity of the principal stream, while the tributary can be greatly swollen. That is the case with the Rhone and the Arve below Geneva.

of forming a series of lake basins which brings them into close connection with processes of mountain-making, has been entirely overlooked. Subsequent attempts to strengthen Sir A. Ramsay's argument have been directed rather to supplying the deficiencies in the former case, than to dealing destructively with the latter difficulty, and later defenders of his hypothesis have apparently deemed silence on this topic more prudent than speech.

The discussion then as to the erosive power of glaciers may be subdivided into three propositions. These are the following:

(1) Lakes are abundant in glaciated regions;

(2) Glaciers are potent excavating agents;

(3) No agent but ice is competent to produce a lake basin.

The first may be briefly dismissed, for I do not dispute its truth. Lakes occupying true rock basins, so far as I know, are commoner in glaciated regions than in any other. At first sight this may seem like surrendering the key of the position. But the concession does not amount to very much; for the tarns of Cumberland, Wales, and the Highlands merge almost insensibly into such lakelets as Windermere and Derwentwater, Bala and Llanberis, Katrine and Lomond, and these again into Zug and Orta, Thun and Brienz, Zurich and Lucerne, Como and Geneva, in a word, into all the Alpine lakes. From these, however, we are led, step by step, to the great lakes of North America, and to those which feed the Nile, the Congo and the Zambesi in Africa. But no one, so far as I am aware, regards these lakes as the results of glacial erosion, or attributes to this either the Dead Sea or Lake Van, either the Aral or the Caspian. But such inland basins seem closely related to those of the Sea of Marmora and the Euxine, and these are hardly separable from the basins of the Mediterranean and of the outer oceans. Obviously then, if some rock-basins have been excavated by ice, dimples also exist on the Earth's face, which are due to other causes, and the concession still leaves individual cases open to discussion.

For the present then let us pass on. As to the second proposition, that glaciers are potent excavating agents, it may be well to remark at the outset that *abrasion* and *excavation* are not identical terms, and that it is not enough to prove the existence of the former in order to establish the latter. How a glacier works must be ascertained by studying the contours of its bed; these can be most readily examined in districts from which the ice has disappeared so recently (geologically speaking) that its foot-marks are still fresh. For this purpose, the higher valleys in the Alps are preferable to the mountain regions of our own island, not only because all the features are on a grander scale, but also because there is no important difference of opinion as to the extent of the glaciers and no complications are introduced into the problem by the possibility of a submergence.

But before examining the effects of ice in the Alps an objection

which has been sometimes advanced must be discussed. When an enthusiastic glacialist is pressed hard by evidence gathered from the Alps, he retorts, "These glaciers are poor, shrivelled affairs. No inferences can be safely drawn from them as to the conditions prevalent in a region enveloped in ice-sheets like those of Greenland." The objection, so far as it applies to the existing glaciers, is not without some justice. The phenomena of the Gross Aletsch Glacier will differ from those of the Jakobshavn Glacier as the phenomena of the Thames differ from those of the Amazon; but it will be after all a difference in degree rather than in kind. The objection, however, becomes less and less applicable as we proceed to examine Alpine valleys some distance away from the existing glaciers. When ice occupied every glen in the Alps; when the confluent sheets welled up against the flanks of the Jura several hundred feet above the level of the present lakes of Neuchatel and Bienne, then the condition of Switzerland was fairly comparable with that of Greenland at the present day. Hence the valleys of the Alps should exhibit the contours of a region from which an ice-sheet has vanished; in any case they must bear the marks of ice-streams which, according to the hypothesis in question, were competent to dig out the Alpine and Sub-alpine lakes. Unless it can be shown that the contours of a valley, down which the course of a glacier can be tracked, differ markedly in its several parts, the Alps furnish us with examples of the action of large ice-streams no less than of small glaciers. But the difference, if any, is never more than one of degree. My experience of the Alps is extensive and of long standing, and I make this statement confidently and without reservation.

Rocks worn by glaciers should testify to the action of a scooping tool, and any valley materially deepened by such a substance as ice (a more or less plastic solid) should exhibit a section bearing some resemblance to the letter U. Let us compare the contours of a region such as Sinai, where glaciers, if ever present, must have been always unimportant features, with those of the Alps. Between the peaks of the one and the aiguilles, or ridges, high above the ice-fields in the other, there is no marked difference—nay, I will go so far as to say that the differences in outline presented by mountain ridges out of the reach of glaciers, whatever may be the cause, depend much more upon the character of the rock than upon altitude above sea-level or the temperature of the region. Frost no doubt is more destructive than heat, but the dominant outlines are alike in climates warm or cold. Place before a geologist a series of photographs of Sinai, the Alps, the Caucasus, the Himalayas, the Lofoten Islands, or New Zealand, and if a little snow be introduced into some, and vegetation carefully concealed in all, he will be unable to determine the locality if he is not aided by actual knowledge of the views. To speak only of gneisses and harder crystalline schists: jagged, splintered, and toothed ridges stand out against the sky, sharp-edged

buttresses, grooved by fissures, furrowed by ravines, broken by precipices, descend towards the valleys. Wherever the ice has not left its mark, there, whether the ranges be high or low, whether the crags overshadow tropical ferns or Alpine pines, the features which are sculptured by meteoric influences other than glaciers are substantially the same.

What contours then are exhibited in those parts of the valleys which have been once overflowed by glaciers? The Alps are well adapted for answering this question. This is the sum of their evidence: toothed prominences have been broken or rubbed away, the rough places have been made smooth, the rugged hill has been reduced to rounded slopes

ROCKY HEADLAND WORN BY ANCIENT GLACIERS OF THE AAR AT THE GRIMSEL HOSPICE, SWITZERLAND.

of rock "like the backs of plunging dolphins." But the crag remains a crag, the buttress a buttress, and the hill a hill; the valley also does not alter its leading outlines, the V-like section so characteristic of ordinary fluviatile erosion still remains; all that the ice has done has been to act like a gigantic rasp; it has modified not revolutionised, it has moulded, not regenerated. No sooner do we come to study in detail the effects of the ancient glaciers in the upper valleys of the Alps than we are struck by their apparent inefficiency as erosive agents. Here, where the ice has lingered longest, just beneath the actual glacier, we see that a cliff

continues to exist. Again and again in a valley we may find that on the lee side of prominences crags still remain, sometimes in sufficient frequency to be marked features in the scenery. Let us take as an example a single valley—the Haslithal. The long level delta of the Lake of Brienz extends to a little above Meiringen, there the valley is barred by a craggy ridge, which is cleft by the Aarschlucht. This chasm has been sawn by the subglacial torrent, while the ice itself has moulded every rock on the barrier into billowy undulations. From its crest we look down upon a level meadow, which extends to the junction of the Gadmenthal with the Haslithal. This grassy basin might well be claimed as an instance of glacial erosion—by which indeed it possibly may have been deepened; but if we attribute to this agency the removal of all the rock between the summit level of the barrier and the present meadow-floor, how are we to explain the existence of the steep rocky slope down which the road to Imhof descends in zigzags. The slopes, in the teeth of an advancing glacier, are always comparatively gentle, and very unlike those which are presented by this rocky rib. Again, after the comparatively uncharacteristic slopes which continue for some distance above Guttannen have been left behind, the region of hard crystalline rocks is entered which extends not only to the Grimsel pass but also into the heart of the great Oberland peaks. What contours does this possess? Everywhere, no doubt, ice-worn rocks meet the eye; curving slopes extending far above the valley floor, spurs and ridges, which are now one vast group of *roches moutonnées;* but hardly ever the faintest approach to a trough-like section; instead of this the normal V-like outline characteristic of the action of heat and cold, of rain and snow. Perhaps no district in the Alps exhibits the traces of ice-action on a grander scale, yet these have been only superimposed upon and modify the features of fluviatile erosion. Yet the contours of ice-action and in some cases the very striæ can be traced almost down to the surface of the torrents. But the Haslithal is not at all an exceptional case. I have examined almost every important valley which leads up into one of the greater groups of crystalline peaks in the Alps, with the same result—namely, that the major features, whether in crag, rock, slope, or ridge, are those of the ordinary processes of meteoric and fluviatile erosion, the minor only being due to glacial action. Hence it follows that, when the ice first emerged from the fastnesses of the central peaks, it descended valleys corresponding in their main outlines with those which still exist, say nearly identical in depth and breadth; but at that time every crag was rough, every ridge was sharp or serrate. The ice took possession of the region. It rasped and rubbed, and, when it finally disappeared, the rock surfaces exposed were worn and defaced, like the sculpture of some bas-relief which has been trodden underfoot till only the main outlines of its design can be distinguished. The Val Bregaglia, the Val Mastalone, Val Anzasca, the Valley of the Dranse

and many others have afforded me the clearest proofs that the ice has occupied without materially deepening, excavating, or modifying the glens. Crags which as it advanced must have risen up like peel-towers from the floor of the valley have been buried deep below the frozen mass, and have emerged, worn, rounded, scored, but only so far changed as to have become humps.

The same is true of the limestone regions; but here the valleys as a rule are rather more troughlike in outline, and the results of ice action are more often blurred or removed by subsequent disintegration, so that these districts are less suited for examination.

But surely there are tarns in the Alps? Yes; though if we restrict ourselves to those which unquestionably occupy rock basins, they are not very numerous. Probably they would become relatively more abundant if the glaciers wholly disappeared from the Alps. But these rock-basins commonly occur, as in the more mountainous districts of our own islands, either in corries, that is, at the foot of precipices or steep rock slopes, or else at the back of low ridges of rock by which the valley is almost barred. In these two situations a semi-solid substance like glacier-ice might put forth considerable erosive power—in the one case owing to the sudden change in the inclination of the bed, in the other from a similar cause which acted, so to say, in the contrary direction; for here the ice is forced uphill by the pressure of the masses advancing from behind.

Now, in 1893, after nine more visits to the Alps—not to mention other mountain regions—during which these problems have never been absent from my mind, I repeat the statement made in 1874, that the Alpine "valleys appear to be much older than the Ice age, and to have been but little modified during the period of maximum extension of the glaciers."

I pass on to another question. Does an examination of existing glaciers suggest that as a rule they have much erosive power? An answer to the enquiry may be sought both on the ground from which a glacier has recently retreated, and on that where it is beginning to encroach. But, as bearing on this point, I will for once quote what I have not seen. The Muir Glacier in Alaska is surely big enough to do a little erosion on its own account. It is 25 to 30 miles long. It is now, however, smaller than formerly, and in retreating has exposed a mass of gravel over which, according to Dr. Wright, it has once flowed. This does not indeed lie in the path of the main stream, but still some erosion might be expected. The stems of dead trees are still upright, rooted in the soil in which they formerly grew. The ice then has passed over this gravel without disturbing it, and the glacier can be seen in other places still resting on a similar gravel.* The glaciers of Greenland, according to Mr. Whymper, leave uncovered in their retreat

* Wright, 'The Ice Age in North America,' chap. iii.

level surfaces, without any sign of basins, and inequalities in the hardness of the rock masses produce little or no effect upon the surfaces worn by the ice.*

In the Alps about the year 1860 the glaciers began to dwindle. By 1870 considerable tracts of bare rock or *débris* were exposed, which a dozen years before had been buried under the ice. On none of these have I seen any basin-like hollow or sign of excavation as distinguished from abrasion. The Unter Grindelwald Glacier in the last stage of its descent passes over three or four rocky terraces. The angles of these are not very seriously worn away, nor are hollows excavated at the base of the steps. The bed of the Argentière Glacier (I made my way some little distance under the ice) was rather unequal, and was less uniformly abraded than I had expected. "There were no signs whatever of the glacier being able to break off or root up blocks of the subjacent schistose rock: it seemed simply to wear away prominences." This also is true of other glaciers.

But prior to 1860, and again in 1891, I saw glaciers which were advancing. What did these accomplish? They ploughed up the turf of a meadow for a foot or two in depth; they pushed moraine-stuff in front of them, showing some tendency to override it, and nothing more. But further testimony may be obtained in respect to this enquiry by examining ground from which glaciers have recently retreated. In 1875, at the foot both of the Glacier des Bois and of the Argentière Glacier, was a stony plain. Both these proved to have been recently uncovered by the ice; in other words, the glacier had not been able to plough up a boulder-bed even at a place where, owing to the change of level, some erosive action not unreasonably might have been expected. But, further, on both these plains big blocks of protogine were lying.† These were striated on sides and top, thus showing that the ice had actually flowed over them, as if it were a stream of mud. Here, however, we might be reminded of the insignificance of the Alpine glaciers. Permit me then to point out that these localities must have been buried beneath ice when a glacier covered the area of the Lake of Geneva, and must have continued to be buried for centuries and centuries after the ice had melted away from every lake-basin in Switzerland or Italy. But it may be urged that in the glacial epoch this district was covered by *névé*, and that *névé* does not excavate. Speaking for myself, I think its erosive power is small; but, if so, there will be a schism in the ranks of glacial erosionists, for then glaciers cannot have excavated cirques, and to admit this would entail unpleasant consequences; so I

* 'Scrambles in the Alps,' chap. vi.

† One in front of the Glacier des Bois was 12 by 8 by 4 yards; the largest before the Argentière Glacier was 12 by 7 by 5 yards. I think it very probable that these larger blocks at any rate were dropped at a late period in the history of the glacier, and are only temporarily overflowed by ice.

content myself by observing that *névé* would cease to occupy a district barely 4000 feet above the sea some time before the glaciers could be called insignificant. So far then as the evidence goes which I can collect from the Alps, and, I may add, from all that I have seen in Britain, the Pyrenees, Norway and Canada, the lakes which are due to glacial erosion (*i.e.* removing all dams of moraine or drift) are rather local, small, and shallow.

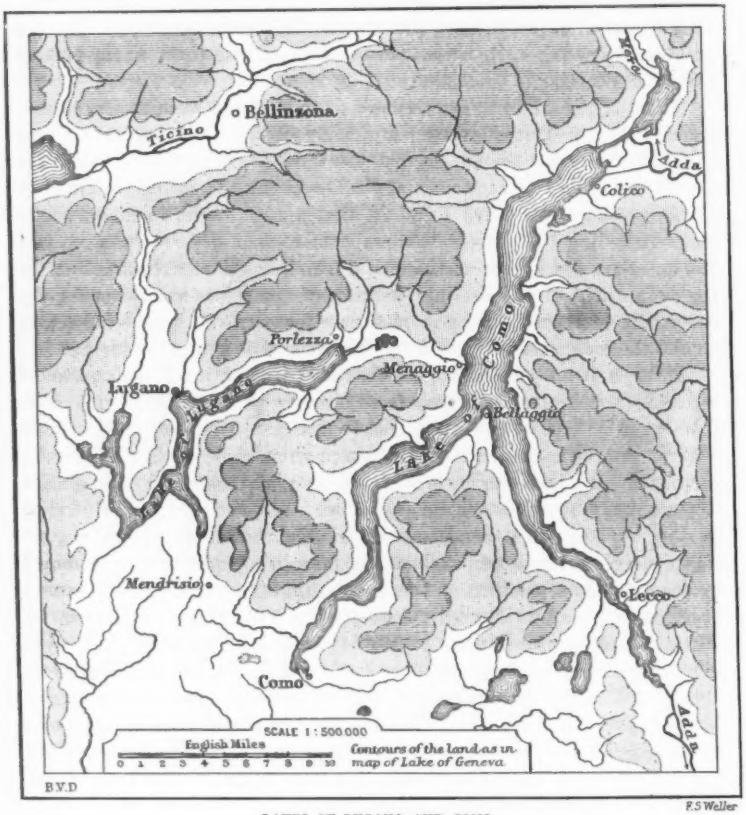
I pass on now to consider certain difficulties presented by the greater Alpine lakes when we attempt to attribute them to the erosive action of glaciers.

First, in regard to their position: some of them, such as Constance, Geneva, Como, Maggiore, &c., are comparatively near to the lower limits of the great ice sheets, and so would be covered for a relatively short time. All of them are many miles from the ends of the existing glaciers, yet we are asked to admit that a rock basin, in depth sometimes exceeding 1000 feet and generally more than 500, has been scooped out in a time much shorter than that which has proved insufficient for the obliteration of the original features of the upper valleys or for the deepening of their beds by more than a few yards at most—indeed, as a rule, the ice seems never to have been able to overtake the torrent.

Perhaps it may be answered that a stream of ice like a stream of water has not the same erosive force in every part of its course. Probably that is true; but we may fairly decline to take account of this general statement until we are informed what there is in the physiography of each lake region to account for the quickening of a glacier from an inert to an energetic condition. We find no marked change in the level of the ground, no remarkable confluence of valleys, no conspicuous straits through which the crowded ice-streams were forced by the relentless pressure of the masses behind. Surely Como cannot be accounted for by the slight descent from Chiavenna, or Geneva by that from the rocky barrier of St. Maurice, or Brienz by that from the Aarschlucht, while Constance, Zurich, and Wallenstadt, Maggiore, Orta, and Garda, are hopeless puzzles? Moreover, what are we to say of the Achensee, that deep lake, so strangely nestling among comparatively low limestone peaks; or of Zug, half sheltered by the block of the Rigi; or of Lugano, with its radiating arms enclosed on almost every side by mountains comparatively low?

Let us turn to another group of facts. The general outline of certain of the larger Alpine lakes, such as Constance, Zurich, Geneva, and Garda, at first sight is not unfavourable to the idea that they have been excavated by a glacier, but serious difficulties are presented on closer examination. The water from a considerable extent of the south side of the central range in Tyrol passes away down the valley of the Adige; during the glacial epoch the ice must have followed the same path. Yet no lake records the fact, and if one ever existed it must

have been small and shallow. The Lake of Garda lies, no doubt, in the path of a glacier, but this drained an area comparatively restricted, occupied by mountains far from lofty. The crags and headlands in the middle part of the lake are curiously unlike, in their general outlines, what might be expected as the ruins left in the track of a gigantic scoop which has dug out a basin, in one place full 900 feet



LAKES OF LUGANO AND COMO.

deep. Geneva also does not lie in the path of the thickest part of the ancient glacier, but as it curves round towards the south it follows a line along which the scooping force must have been comparatively slight. As will be presently seen this initial difficulty is strengthened by a closer study of the form of its bed. Again, how are the radiating arms of Lugano and Lucerne to be explained? Supposing the orographic features of these districts in each case to be first outlined and the

valleys excavated down to the present water level, what is there in the structure of either to explain the scooping out of lateral valleys? If the recurved hook and lateral bays of Lugano are the memorials of as many ice streams, it may be fairly asked why almost every transverse tributary valley in the Alps is not also provided with a lake? In the case of Lucerne how was the Küssnacht arm of the lake produced? Did a glacier plunge headlong down the little slope made famous by the legend of the "hollow way," or did the ice stream either from the Brünig Pass or from the Engelberger Thal crawl across the back of the glacier of the Reuss Thal, like one snake over another, and then compensate itself for this feat by excavation? Perhaps such an intertwining of ice streams would not be too great a trial for the faith of some glacialists, but speaking for myself, I should like to be supplied with a few corroborative facts before removing it from the imaginative poetry to the sober prose of science.

But the Lake of Como is even more perplexing, if regarded as an instance of glacial erosion. Its subaqueous contours present serious difficulties; but for the moment only those which meet the eye shall be noticed. The lake in form roughly resembles the letter Y, its base pointing to the mountains. The water flows out of the eastern, or Lecco, arm; the western, or Como, arm is closed by a line of sandstone hills (molasse), which rise a few hundred feet above the level of the water. The original lake basin extended nearly up to Chiavenna; its present length, measured to Como, is about 31 miles, and to Lecco about 24 miles. The deepest part of the lake is 1341 feet—642 feet below sea-level. Chiavenna is only about 350 feet above the lake, and the valleys tributary to the Maira do not descend from very high mountains, since those draining the principal peaks of the Bernina group enter the Val Telline; and the junction of that huge tributary produces no appreciable effect in widening the main valley. Thus we are justified in asking how it was that the ice suddenly acquired this erosive force, after having been previously such an inefficient excavator. Again, if it be assumed that the valley was carved out by ordinary agencies nearly to the present lake-level—for without this assumption I cannot account for the existence of the promontory of Bellagio, and the severance of the ancient glacier into two forks—let us proceed to examine the western, or Como, ice-stream. It passed over the site of the town; it climbed the slopes beyond, for their beds of conglomerate are smoothed and striated; it crossed the sandstone ridge, leaving blocks of granite from near the Forno and Albigna glaciers poised on its crest, and piling up moraines on the lowland some distance away to the south. How, then, has this projecting barrier of comparatively soft sandstone escaped from being planed flat by the ice which was so potent an agent as to dig out the long basin to the north? So little has it suffered, that its crest is a ridge, unusually narrow and sharp, often only a few feet, hardly ever a

few yards, across, with steep slopes on either side. The lower end of the Lake of Orta, from the northern part of which water is discharged to the Lago Maggiore, affords a similar and no less puzzling problem. Not less perplexing are the subaqueous contours of the Lake of Como. The arm ending at that town is deeper than the upper lake, its bed for a considerable distance being about 1300 feet below the surface; while the basin north of Bellaggio, with a maximum of 1116 feet, is less than 1000 feet deep as a rule. But nearly opposite to Bellaggio, just below the point of division of the ancient glacier, and where we should suppose its erosive force to be still very great, the bed of the lake rises to within 438 feet of the surface. The basin of the Lecco arm, however, is shallower than that of the upper lake.

The subaqueous contours of the Lake of Geneva, recently described in Professor Forel's monograph,* do not lend themselves very readily to any theory of glacial excavation. As a physical feature it is later than the middle of the miocene period. Its slopes, and almost certainly its bed, are covered with glacial *débris;* its waters once stood at a higher level.† It consists of a wide deep upper basin and a narrower and shallower lower one. In the former, at the base of the cone of *débris* deposited by the Rhone, the lake-floor is a broad, nearly level, plain, about 300 m. (984 feet) deep. The contours of its sides are evidently closely related to those of the slopes which rise from its margin. The fall is rapid, almost precipitous, beneath both Chillon and St. Gingolph. West of Vevey it is about 1 in 4, changing gradually to 1 in 10 opposite to Ouchy. The rise at the western end of the basin is gradual, and the depth at the barrier of Promenthoux is only 75 m. (246 feet). The other basin—the Petit Lac—between this place and Geneva, is a narrow, shallow trough, the bottom of which rises very slowly from a depth of about 70 m. (230 feet) to 50 m. (164 feet), thence gradually mounting to the efflux of the Rhone; but the continuity of the floor is slightly interrupted by five small shallow hollows,‡ roughly linear in arrangement. No alteration in the level of the lake-bed corresponds with the change from the comparatively hard limestone about the upper end of the larger basin to the comparatively soft sandstone of its lower end. The shallowing up to the barrier of Promenthoux and the Petit Lac itself do not seem related to the ancient glacier, for, so far as we know, its line of maximum thickness, which might be expected to indicate its greatest erosive force, pointed towards Neuchatel. If this glacier were competent to excavate the lake, surely it should either have worked steadily along the line of the Rhone to Geneva, and thus made a lake changing gradually in outline and depth, or have kept on more nearly along the axis of the upper lake.

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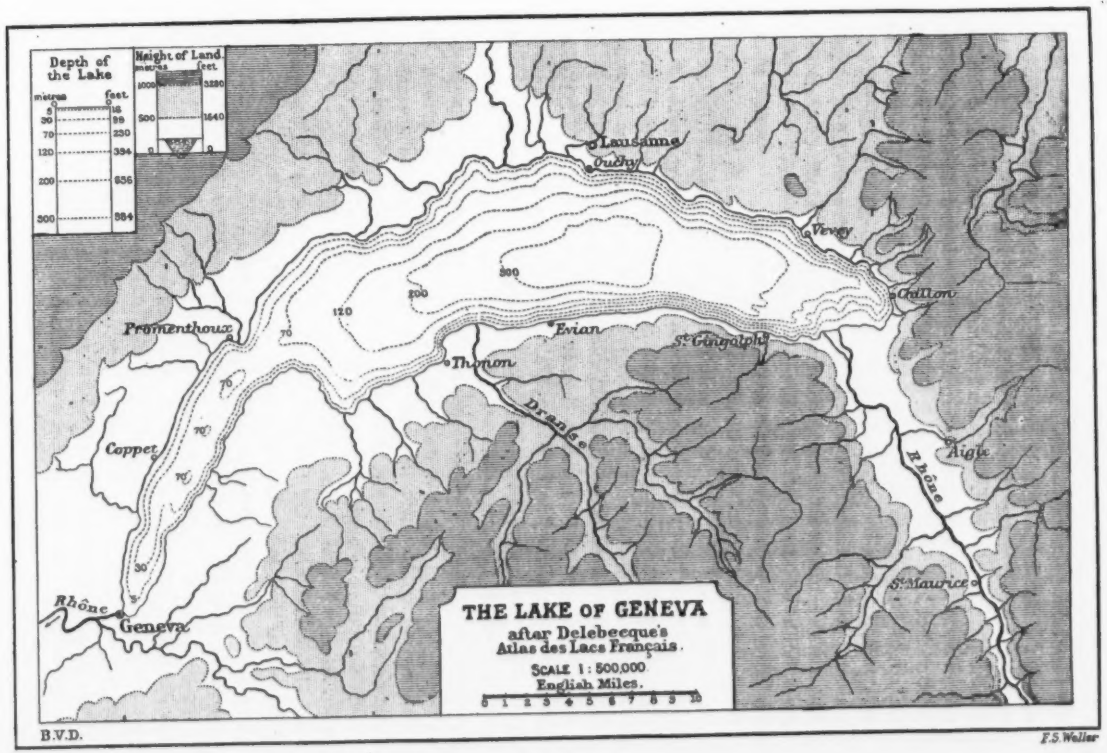
* Le Léman 'Monographie Limnologique' (tome premier).

† Not less than 100 feet, and possibly higher.

‡ These sink from 15 to 20 feet below the general level.


Depth of the Lake
metres
feet.
Height of Land
metres
feet.
Lausanne
Ouchy
Vevey
Chillon
Evian
St. Gingolph
Thonon
Promenthoux
Copper
Dranse
Rhône
Aigle
St. Maurice
Geneva
THE LAKE OF GENEVA
after Delebecque's
Atlas des Lacs Français.
SCALE 1 : 500,000
English Miles.
B.V.D.
F.S. Weller

An atlas of about twelve French lakes, including that of Geneva, has been recently published by M. Delebecque, of Thonon. In one of these a submerged river channel can be traced across a rather wide part of the lake. In most the depth diminishes wherever the shores approach. In the Lac de Bourget the slopes of the Mont du Chat are prolonged under water to a depth of about 300 feet—*i.e.* nearly to the lowest part of the bed. In short, almost every one of these lakes presents some anomaly hard to reconcile with a theory of glacial erosion.

One fact to which Professor J. Geikie has called attention,* seems at first sight strongly to support Sir A. Ramsay's hypothesis, and is the only real addition, in my opinion, which has been made to the original reasons. It is that many of the Scotch lochs are true rock basins, and that similar basins frequently occur outside their mouths. This also often holds of the fjords in Norway, New Zealand, and elsewhere. Professor Geikie points out that several of these basins occur just when the ice might be expected to obtain an increased scooping power. His map at first sight appears very convincing; but a study of the larger charts reveals many anomalies. Loch Linnhe, for example, from below the entry of Loch Leven, maintains a general depth of from 34 to 50 fathoms; then, below Loch Corrie, a channel may be traced which varies in depth from 50 to 60 fathoms, after which, in the Lynn of Morven, we find it deepen to 70 fathoms, then to 90 fathoms; and at last a little north-east of the line joining Barony Point with Lismore Point, it expands into a basin with a maximum depth of 110 fathoms. But outside, in the Sound of Mull (to the north-west) the depths become very irregular, varying from about 35 to 70 fathoms. Barony Point appears to be connected with Mull by a submerged isthmus, generally less than 20 fathoms below the surface. But here, if the glacier were stopped by impinging on Mull, it ought in splitting to be pushing hard upon its bed. In all this region the irregularities of the ice-bed are very perplexing, whatever hypothesis be adopted; but I will restrict myself to a single instance. Off the west coast of Scarba, under the lee of the "Islands of the Sea," and where the opening towards Colonsay makes it improbable that the ice can have forced into a narrower space, an elongated basin occurs in which the soundings—outside about 60 fathoms—deepen to 100, and at one place to 137 fathoms. The sea-bed about Arran presents similar difficulties. In short, here, at Loch Etive, Loch Lomond, and in other places, all goes well only so long as we restrict ourselves to generalities and abstain from details.

The Sogne Fjord in Norway is a remarkable basin. As its arms unite, its bed sinks to 511 fathoms at the mouth of the Aurlands Fjord; then descends gradually down to 567 fathoms, after which for a long way the soundings vary from 637 to 660 fathoms; but on reaching the outer

* 'The Great Ice Age,' p. 519.

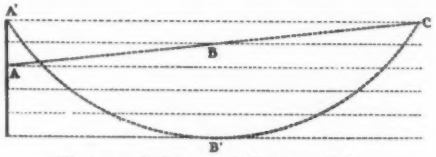
islands the sea-bed rises till it comes within the 100-fathom line. There is nothing, however, in the contour of the fjord to account for the marked increase of depth, while the opening at the islands seems insufficient to explain the shallowing; for the ice stream, according to the modern school of geologists, swept out far away to sea at the time of maximum glaciation.

The Vest Fjord also offers a number of difficulties, of which I must mention one only—namely, that a channel about 200 fathoms deep lies near the Norway coast to which the sea-bed descends very gradually from the Lofoten Islands. But the latter, as their outlines show, cannot have given birth to glaciers comparable with those of the mainland. Hence the scooping effect produced by the struggle between the opposing ice streams should have been manifested on the western, not on the eastern side of the fjord.

From these and other instances I infer that these singular basins, as a rule, have not been excavated by glaciers. Unequal subsidence frequently appears to occur. The movements near a coast-line often seem to be far from uniform. It must be remarked also that moraines are often left by retreating glaciers, and if these are on a scale at all similar to those of the old Alpine glaciers, very considerable inequalities would be produced. To such a cause the curious irregularities in the bed of the St. George's Channel seem—in part, at least—to be far more probably due. At any rate, I have never been able to connect them with any theory of glacial excavation. In short, the evidence of lochs, fjords, and the neighbouring sea-bed, does not appear to me sufficiently convincing to outweigh the arguments in the contrary direction.

The evidence which has been summarised above seems to lead to the conclusion that the excavatory power of glaciers has been much exaggerated. The European glaciers generally have not been very potent agents of erosion or even of abrasion, probably because the glacial epoch was comparatively of short duration. But I may be fairly expected to offer an hypothesis as a substitute for that which I discard. This was done full twenty years since, during which time advocates of the other have been almost unanimous in "letting it severely alone," but since then the evidence in its favour has been strengthened. Strange to say, this hypothesis was overlooked by Sir A. Ramsay when he claimed a victory for his own one, not so much for its positive merits as on the ground of its being the only one that held the field. Yet the hypothesis has always appeared to me one of the most simple and natural. It is this. The lakes above and below water present, as we have seen, the contours of ordinary valleys. Suppose them to have been eroded by the ordinary agencies, among which ice would sometimes play a subordinate part, and their beds to have been subsequently affected by differential movements. If the lateral pressures by which

a mountain chain has been formed have begun again to act after an epoch of comparative rest, during which the folded masses have been carved into peaks and valleys, it is more probable that alternating zones parallel with the axis of the chain would be affected by uplifting and down-sinking movements than that the massif would rise or sink uniformly as a whole. Probably, if such differential movements were comparatively slight, they would be more marked towards the outer part of the chain nearest to the region on which incoherent materials had more recently been deposited. Suppose then the outermost zone to rise and the next within it to sink, that part of the river valley would at once be converted into a lake. As a simple illustration take two points A and C in a valley 20 miles apart, and B half-way between them, and suppose the fall to be 10 feet a mile; B is 100 feet above A, C the same height above B. Suppose C to remain fixed, B to sink 400 feet, A to rise 200 feet, *i.e.*, to the level of C. A basin is now formed 20 miles long, which at its middle point under B is 500 feet deep. But it might be urged that evidence of such a flexure should be afforded by the rocks themselves. Suppose they had originally been horizontal—

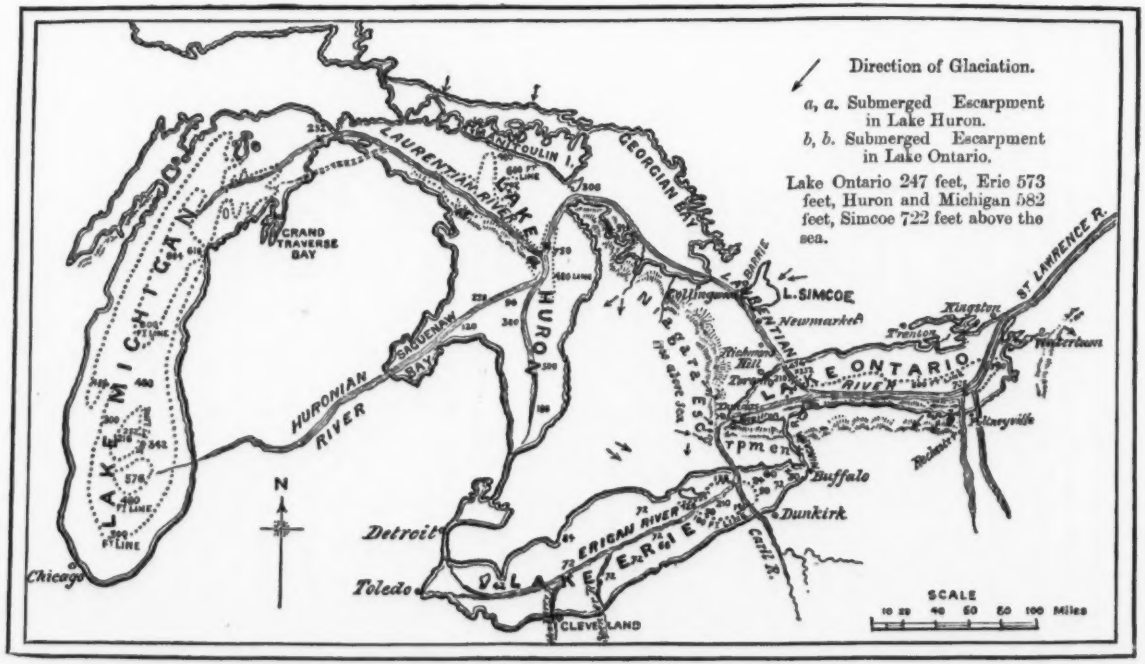


The intervals between the horizontal lines represent 100 feet.

they would now, between A and B, dip from the former to the latter at an angle measured by 500 feet in 10 miles, not quite 1 in 100, *i.e.*, less than one degree.

Such a case, however, is exceptionally favourable; as a rule the strata were considerably flexured, and folded long before the lake basin was formed, so that the detection of so trifling a disturbance is an impossibility. It is obvious that the effects of such a depression in a valley which was fairly regular in form would be to make the broadest and deepest part correspond. At the same time the contours of valleys are so variable, and depend so much on the nature of the rocks through which they are cut, that deviations from this rule are to be expected.

But we may be fairly challenged to cite any instance of lakes which have been produced by differential movements of the Earth's crust. Extreme glacialists formerly cast longing eyes at the great lake-basins of North America. They lie within the territory once occupied by an ice-sheet; they are true basins of considerable depth. Of late years their beds have been studied, and a convenient summary of the results



THE ANCIENT LAURENTIAN VALLEY NOW OBSTRUCTED AND FORMING TH GREAT LAKES. (*From the Qy. Journ. Geol. Soc.*, 1890.)

is given by Professor J. W. Spencer.* I must content myself with the veriest outline. Lake Michigan is divided into two basins—the northern, 864 feet deep, the southern, 576 feet—by a broad plateau, about 450 feet below the surface. An old river channel, now choked by glacial drift, connects the latter basin with Saguenay Bay, in Lake Huron; the other one was united with that lake as at present, but also by a buried channel. Huron formerly did not drain, as it now does, into Lake Erie, but its slopes converge opposite to the opening between the southern end of Manitoulin Island and the mainland, and the valley thus formed can be traced through Georgian Bay to its southern end, whence another choked-up valley leads into Lake Ontario, west of Toronto. Erie, thus separated wholly from Huron, drained, also by a buried valley, into Ontario. In Huron and Ontario submerged escarpments have been detected. The contours, then, of this lake system, if it could be cleaned from the glacial *débris*, would resemble those of a system of river valleys. The lower part of the St. Lawrence has been proved to be a submerged river channel, and indicates a change of level amounting to some 1800 feet. At the present time Michigan is 582 feet above sea-level, and a portion of its bed more than 250 feet below it. The deepest part of Ontario is as much as 500 feet below this. But differential movements have continued since the lakes were formed, for the "Iroquois" raised-beach is full 600 feet higher at the north-eastern part than it is at the western end of the lake.

To conclude, glaciers, when the paths which they have traversed are carefully studied, appear to have acted, as a rule, as agents of abrasion rather than of erosion. Even in the former capacity they have generally failed to obliterate the more marked pre-existent features due to ordinary fluviatile and subaerial sculpture. In the latter capacity they seem to have been impotent, except under very special circumstances; thus, while we may venture to ascribe to glaciers certain shallow tarns and rock basins in situations exceptionally favourable, we cannot assign to their agency either the greater Alpine lakes or any other important lakes in regions which were overflowed by the ice only during the period when it attained to an abnormal development.

The question which I have ventured to bring before you this evening has been discussed hitherto by the geologist rather than by the geographer. In reality it belongs to the wide neutral zone which lies between the two provinces of scientific investigation. In my treatment of it I may have seemed to some geologists to be almost abandoning their claims, by practically denying that glaciers are direct erosive

* *Quart. Jour. Geol. Soc.*, 1890, p. 523. Lake Superior, which certainly does not help the glacial erosion hypothesis, is not included. The depth of Michigan is 864 feet, of Huron 750 feet, of Erie 210 feet, of Ontario 738 feet. I am indebted to the kindness of Prof. Spencer and of the Council of the Geological Society for the use of the map illustrating the Paper just mentioned.

agents of the first magnitude. But however we may differ on this question, we should all agree—and this no less concerns the geographer—that glaciers have a most marked, even if it be a somewhat superficial, influence on scenery, and that by acting as storehouses of water and feeders of rivers they indirectly play a most important part in the work of earth-sculpture.

Before the reading of the paper the President said: To-night we make an excursion, I will not call it an incursion, into the territory of our neighbours the Geological Society. I think it is very desirable that we should make these excursions from time to time, if only for the purpose of showing that we claim to concern ourselves with everything that belongs to the theatre in which man lives and works. The eminent geologist whom we welcome to-night is known to all of you by name, and to some of you personally. I am sure that you will all listen with the greatest attention to what he has got to say, and I am not the less sure that when he has concluded his observations some members, to whose opinions also we attach great importance, will attack his views.

After the reading of the paper the following discussion ensued:—

Dr. Blanford: I am sorry the task of replying to Professor Bonney has not fallen into the hands of some one better qualified, for although I am prepared to defend the views of the late Sir Andrew Ramsay, of whom I was a pupil, I am at the same time not willing to go to the extent he did, and I do not attempt to suggest that the great lakes of America are due to glacial action. With regard to the moderate sized lakes of the Alps, such as Como or Geneva, the question is a very difficult one indeed, and if I were to attempt to go into it I should take as long to put the other side as Professor Bonney has done in laying before us his admirable summary of the arguments of the anti-glacialists. The chief points I should like to urge upon you are first, that I think Professor Bonney rather underrates the effect of erosion by ice. Not the ice but the stones imbedded in it scrape away the rocks upon which they impinge, just as the emery or diamond dust on the wheel of a lapidary grind down a gem. I cannot admit that the shape of a valley eroded by a glacier is the same as that caused by ordinary fresh water action. In Europe we are likely to forget that the big valleys among our mountains are glacial valleys, but if you go into countries where no glaciers ever acted and come upon the typical V-shaped valleys you see the difference immediately. In the Himalayas there are U-shaped valleys at higher and V-shaped at lower elevations, the higher ranges are the same in appearance as in the Alps, but the different form of the lower valleys strikes you at once. The evidence of erosion in glaciers does not depend upon what a glacier in its most effete stage can do, but the proof that glaciers do erode is to be found first of all in the very simple fact that the water issuing from beneath a glacier is always thick with mud. If ice has no effect in eroding what is the origin of the boulder clay? High up upon the sides of numerous peaks in countries affected by glaciers you find curious little tarns; there is one on the north side of Cadr Idris, one or two on Snowden; one of the most interesting I have seen is on the east slope of Snæhette in Norway; in this case there is a little glacier coming down from the peak ending in a lake about ½ mile long. An extremely good instance of a rock-basin formed by erosion is Easedale Tarn above Grasmere. Professor Bonney agrees that such tarns must have been excavated by ice action, but then comes the question where is the line to be drawn. As Professor Bonney has pointed out you may begin with tarns and go on by almost imperceptible

gradations to the biggest lakes in the world. This was the argument maintained by Sir Andrew Ramsay, the only difference being that Professor Bonney begins by showing that the larger rock basins cannot be glacial, while Sir A. Ramsay commenced with the little tarns and showed the gradual passage from them to larger lakes. That the smaller tarns are due to glacial erosion is easy of demonstration, but the difficulties become great when we come to lakes like Como, because it is not easy to understand how glaciers can work down to that great depth and rise up again, and excavate a deep basin while moving over so long a space. On the other hand it is a curious and extraordinary fact, as Sir Andrew Ramsay pointed out, that in the area where ice has had effect lakes abound, but where no ice has affected the surface lakes are few in number. At the base of the Himalayas no lakes are found. The Himalayas are probably more recent than the Alps, as the beds of sandstone, conglomerate, etc., found disturbed at the foot of the Himalayas are more recent than those found in the Alps, so that if lakes are due to disturbance and tilting only, they ought to be at least as numerous in the lower Himalayas. Then we come to a most difficult question, that of fjords. You find them in Norway, on the west coast of Scotland and in America; one of the most typical being that of the Saguenay running into the St. Lawrence; it is excessively deep and terminates in a comparatively shallow sea. Why should fjords of this peculiar character be found so often in high latitudes where we know ice played a part, and why are they wanting in the tropics? In the tropics are found valleys depressed much below the sea-level. At the mouth of the Persian Gulf on the western side are numerous inlets formed by depression, well surveyed, because the telegraph cable was at one time carried across, but having by no means the characters of fjords. This then is the crux that remains to be solved, where we know that ice sheets and glaciers have existed we have lakes in large numbers, and the peculiar phenomena of fjords, but they are not to be found in places where so far as we know ice has not been. I do not mean to say positively that the larger rock-basins have been excavated by ice, but at the same time if no other theory save that of tilting is put forward, how does it come to pass that tilting has only taken place where ice has been. I must say that so far Sir Andrew Ramsay's theory holds its place.

Mr. Douglas Freshfield, President of the Alpine Club: Some years ago when, as editor of the *Alpine Journal*, I had the privilege of being in correspondence with Mr. John Ruskin, he concluded one of his letters to me with the following characteristic sentence: "I hope that some day the members of the Alpine Club may desire to gather together their knowledge of glaciers and make a wholesome end of all glacier theories by due acknowledgment of James Forbes's conclusive ascertainment of glacier facts. They owe this duty to science, and should, it seems to me, take honourable pride in fulfilling it." I do not think the Alpine Club can be accused of having failed in doing its part in the work Mr. Ruskin proposed for it; in bringing, that is to say, recent geological theories into close contact with geographical facts. Mr. Whymper, as we all know, in his book on the Alps, entered largely into the question of glacier action, and since that time four Presidents of the Club—our late respected and beloved Fellow and Councillor, Mr. John Ball, Mr. William Mathews, Mr. Bonney (whom you have heard to-night), and last and least myself, have done our best to show that the geological theory of glacial excavation is inconsistent with the topographical facts as we and others have seen them, and that it is supported mainly by appearances which I may fairly call superficial. It would be preposterous in me to imagine that anyone here remembers, or that more than a few have read, a paper which I printed in December, 1888, in our Society's *Proceedings* upon "The Conservative Action of Glaciers." I cannot now recapitulate the facts I gave there; I can only refer to them. Among other things I pointed out how Sir Andrew

Ramsay himself had admitted the incapacity of glaciers in excavation. He writes for instance: "One great fact which the striations teach is this, that the broad and thick ice-sheet, urged on from the north, buried the whole of the region described; and, further, that the glacier moulding itself to the shape of the country (after the manner of all glaciers) was pressed right onward with so much force that the long northern slopes of the east and west valleys offered, comparatively, no more impediment to its onward march than an occasional transverse bar of rock hinders the onward flow of a river." It is physically certain, I believe, that ice must do most work in abrasion where its weight and velocity, its pressure and friction, are greatest. What we claim to show is that among the existing glaciers of the Alps you cannot find one which, where its weight and velocity are greatest, has done more than smooth and polish resisting protuberances and carry on loose material—not one which has done any serious excavation. Many of those present must have visited the end of the Mer de Glace, the Bossons Glacier, the Brenva Glacier, where they descend into the valleys. The ice has retreated of late, and let us see what it has done under its bed. These glaciers have left no lake-basins in their retreat; they have rather raised than excavated the ground. There is a steady upward slope from the village of Chamonix to the end of the Glacier des Bois. Turn to extinct glaciers. The old glacier of the Valley of Aosta could not widen the gorge of Bard; it left undisturbed on the plain near Ivrea gravels deposited before its visit. The old glacier of the Rhône had to mould itself to the narrow limits of the gorge of St. Maurice; where it was met by a great tributary from the Valley of the Arve, it dug no basin. The depths of the Lake of Geneva do not correspond to any sudden increase in the ice's volume or velocity. Look, again, across the Atlantic. The enormous Alaskan glaciers do not uproot tree-trunks; the Greenland glaciers break against the Nunataks; they do not remove them. Even the mighty ice-sheet that once spread across the North American continent had no power of destruction. I challenge our opponents to meet the facts set out in the Reports of the United States Surveyors I quoted five years ago. If then we find no modern glaciers digging lake-basins, how can we believe that the hollows on the earth's surface were made, or in any great part made, by glaciers? Dr. Blanford's argument from the frequency of tarns in mountain regions may be retorted upon himself. Some parts of the Alps are thickly set with tarns; true, but other parts, once equally glaciated, are not. The tarns occur in particular geological formations. In the chain of the Caucasus, 700 miles long, there are no lakes, there is hardly a tarn. What have the Caucasian glaciers been about, if it be glaciers that make lake-basins? Lake-basins, we admit, sometimes (not always, by any means) exist near and on glaciated ranges. Yes; and there will be found sufficient reasons for the fact. Where on the surface of our globe there are heights, there must be hollows; where there are central ridges, there will be furrows also, and parallel elevations. Then there must be basins; and until torrents, acting as saws, have tapped them, or, acting as mud-carts, have choked them, these basins will hold water. Another class of lakes will be formed by moraines acting as dams. There are many of these in New Zealand. The history of the hypothesis I am combating is not an uncommon one. There is a great deal of human nature in it. Geologists, like the simple children of the Syrian desert who attribute anything great to Alexander, have been apt to account for any strange phenomena by an heroic cause. At one time it was an universal deluge, or many partial deluges. Even De Saussure belonged to this school: he thought erratic blocks had been distributed by some mighty flood. Then there was the theory of volcanic, or igneous action: of catastrophes. Lastly, the true origin of erratic blocks was discovered, and the scratches and rubbing of the ice recognised. These superficial appearances were found over vast

areas. Ice became the new toy for science; and one of the ways in which science shows its eternal youth is in its passion for new toys! I will briefly point out, in conclusion, some of the effects glaciers have produced on contemporary landscape, and their geographical importance. Professor Heim of Zurich, whose important work is very insufficiently known in this country,* has laid down the law that "glaciation is equivalent to a relative cessation in valley formation." The cloak of ice protects the soil from the alternations of heat and cold; from floods and earth-slips and mud-avalanches. Water is at work under the ice, but under strict limitations. The torrent that has made its plunge in some *moulin* carves secretly and silently a deep, narrow cleft. Consequently, the traveller after passing the moraine-heaps which mark the most recent considerable extension of the glacier, finds the valley more U- in place of V-shaped, and at the same time shallower. Any rocky barrier across it shows convex surfaces smoothed and scratched by the glacier on the side opposed to its advance, and is slit through by the gash cut for itself by the once sub-glacial stream. Such are the features of the well-known Kirchet, near Meyringen. Of course it follows that some of the solid matter found in glacial streams is due to their own erosion, and not merely to the pounding together as they move along of the blocks to which the ice is serving as carrier. The bottom of a lately glacier-covered valley is flat because the ice has protected its bed from sub-aerial denudation; as well as from the inroads of earthslips and the fan deposits of side-streams. I saw once in the Caucasus an enormous mountain-fall carted clean away and carried ten miles by one of the glaciers of Ushba. The glacier was acting not as a spade but as a sledge. I could easily go on talking about the ways and varieties of the glaciers I have known; but I must not detain the meeting longer, lest the question before us should be changed from "Do Glaciers Excavate?" into "Do Glaciers Bore?"

Sir Henry Howorth: I think it is a little hard upon my friend Professor Bonney that I should be called upon to speak on his side, as he is himself fond of fighting. This week I am publishing a big book, in which I propose to do my best to speak plainly about the views of the ultrà glacialists, and to-night I must limit myself to one or two points. The first point is, that they have no right to appeal to ice until they prove the potency of ice to do the work. Now the mathematicians have shown that ice, under the pressure required to excavate a lake after travelling over a flat plain, would be crushed long before it reached the lake. It is thus shown that such excavation is a mathematical impossibility, as you have to import into ice an entirely new force before you can make it excavate. It is not a question to be treated on theoretic grounds, as it is often treated. You must ground your argument on some solid base before you are justified in proceeding at all. The arguments put forward by Sir Andrew Ramsay and Professor Tyndall on this subject, urging that all lakes and valleys are excavated by ice are mutually destructive, as one insists that the ice gradually loses its force, and the other declares that it must keep its force. Both these men wrote, long before it was proved that Forbes was right (to the very letter) in maintaining that ice, instead of being a rigid mass, or nearly so, travelling over slopes and great level plains, is, in fact, a viscous mass moving as water moves, and that when it ceases to get the impetus from the slopes behind, it ceases to move and work at all. Experiments published in the 'Philosophical Transactions of the Royal Society' proved that Forbes's grand generalisation was perfectly true, and proved also, it seems to me, that ice is an impossible agent to appeal to as an excavator. We are told to-night that these lakes only occur in regions which have been occupied formerly by

* Heim, 'Handbuch der Gletscherkunde.' See Review by Mr. F. F. Tuckett in *Alpine Journal*, vol. xii.

glaciers. The fjords have also been appealed to. Dana, as far back as 1849, was the first to appeal to ice as the excavator of fjords. Now these fjords exist in many places where, so far as we know, no ice or glacier ever existed at all. Falsan has shown that all along the southern shores of France, in Dalmatia, and on the shores of Asia Minor, fjords exist. Now the Austrian geologists who tramped in search of evidence of ice action all over European Turkey, could not find a trace of an old glacier. There is the remarkable fact also pointed out by Mr. Freshfield, that in Greenland, where the study has been carried on notably by one remarkable Englishman who lived there twenty years, and whose papers have been overlooked, and also by Peterssen, who both show that on the spot nothing like excavation by these enormous glaciers with their rapid motion can be found. My friend Dr. Blanford says if you do not appeal to glaciers, what about the boulder clay? I say boulder clay has not been formed by glaciers at all. I have been where glaciers are working hard, and, like a good many other people, have absolutely failed to find boulder clay being formed. Boulder clay necessitates an appeal to something more than glacial action, and certainly we find nothing in the moraines of glaciers in the least resembling boulder clay. There seem to me to be other facts and arguments which preclude absolutely this appeal to ice. Ice is exactly like the sand paper used by the sculptor after his assistant has chipped out the statue. What comes out of the bottom of a glacier, as was said by Mr. Freshfield, in the shape of the so-called glacier milk is largely the result of the rubbing down of the masses that have fallen down the crevasses from the backs of the glacier. A glacier can no more take blocks of stone out of its own bed than a man with his hands tied behind him can pull teeth out of his own head: and the products of erosion we see everywhere are caused by the rubbing of the stones that fall down the crevasses and chafe against the rocky bed. Thus we find that glaciers do not excavate, but only polish. Being a disciple of Professor Bonney, who has done so much to illustrate this question, I could not resist your invitation to say a few words.

Mr. W. M. Conway: Reference has been made to the Karakoram Mountains, and the Himalayas have been described as later than the great range of mountains behind them. I have recently visited a portion of that range, and seen the largest glaciers in that district, notably the Hispar, which is the largest of all. It has, in quite recent times, retreated 25 miles, and is now only 40 miles long. In the first place it has not left a U-shaped valley, but a remarkably V-shaped valley, and there is no trace of the valley having been gouged out; and in the second place, nowhere in the neighbourhood does there remain any lake whatever. This afternoon I saw two men looking in a print-shop window, arguing as to how an engraver had produced a certain effect with the burin; as a matter of fact the thing was a mezzotint. Their discussion reminded me of the arguments regarding lake basins. I think, if the geologists arguing about this matter made themselves familiar with glaciers by contact with many, it would ultimately occur to them that they had never seen one engaged in excavating. I, and many others, have been under glaciers, both in their upper, middle, and lower courses, and have never seen one excavating. They slope and slide in the smoothest possible manner, and here and there do a little scratching. It was looking at the print, and not being familiar with the process, that brought this theory into prominence.

Professor Bonney: My friend, Sir Henry Howorth, Mr. Freshfield, and Mr. Conway have left me very little to say, but I will just touch upon one or two points very briefly. With regard to the St. Lawrence, I may point out that the basin of the Saguenay is formed by a submerged moranic boundary between the valley of the Saguenay and the main valley of the St. Lawrence. With regard to the absence of lakes from the Himalayas, and presence in the Alps, if basins were made by glaciers

the two results would be simultaneous ; so the question of relative age will not come in. With regard to tarns in rock basins, these only occur under most favourable circumstances, where ice may have been expected to have had great erosive power. Now, the argument of my earlier papers was, that if glaciers do excavate, they should make tarns at intervals down the valley. Dr. Blanford forgot that mud from glaciers does not prove erosion, but only abrasion, a distinction which I have drawn; and I quite agree with Mr. Freshfield, a large quantity of mud comes from tributary streams, not from the glacier. Several of the Alpine lakes, in fact, the most important, occur at the ends of the courses of glaciers, where, according to most people, they would be quite impotent to excavate, in fact, where they approach their death-beds. It would seem that glaciers are like some people, who idle away the best part of their life, and try to have a desperate expenditure of good deeds before they leave it. Another point, on which I do not agree with my friend, is that of Alpine valleys. These, as a rule, are not U-shaped, but V-shaped, only being U-shaped in a few very exceptional cases. I have followed up, I should think, half the valleys in the Alps. The upper Haslithal Valley is throughout V-shaped, yet it is ice-worn almost down to the level of the torrent. My argument amounts to this, that if we accept the hypothesis put forward by Professor Ramsay, we are landed in a crowd of practical difficulties.

The PRESIDENT: You will, I think, agree with me in the opinion that Professor Bonney's views have been well smitten and well defended, and will direct me in your name to return your very best thanks alike to him and everyone else who has taken part in the discussion.

PYTHEAS, THE DISCOVERER OF BRITAIN.

By CLEMENTS R. MARKHAM, C.B., F.R.S.

THE discovery of the British Isles in the third century before Christ, by a Greek scientific explorer, was the last link in a chain of events which commenced with the establishment of the Ionian colonies in Asia Minor. We may trace these events as they succeed each other, with ever growing interest, for we shall find that their motive was always a noble thirst for geographical discovery and exploration. The original impulse came from those Ionian colonies in Asia Minor, whose people were gifted with all the Grecian genius for scientific research, for imaginative speculation, and for maritime enterprise. They are said to have established themselves on this coast in about 1060 B.C., to have formed themselves into twelve autonomous cities, to have advanced in civilisation, and to have extended their influence in various directions, during a long period of peace and prosperity, extending over several centuries. Their coast reached for about 80 miles from Phocæa on the north, to Miletus on the south, bordering on Caria; and the Ionian territory included the islands of Chios and Samos. Deeply indented by bays, it is formed into numerous harbours, and the dozen cities were clustered round their shores. First on the north, between the Cumæan and Hermæan Gulfs, was Phocæa, a colony from Ionian Phocis. Then came

the rocky promontory, on which rose the shaggy forest of Mount Mimas, with the island of Chios by its side, and on the shores of the promontory and island were clustered the cities of Clazomene, Erythræ, Teos, and Chios. From Mount Mimas, a great bay sweeps round to Mount Mycale and the island of Samos, and on or near its shores were the cities of Lebedos and Colophon, and the holy city of Ephesus. Point Trogilium, at the end of Mount Mycale, separates this bay of Ephesus from the southern bay where stood the cities of Priene, Myus, and Miletus, with Samos on its fertile island, off Mycale.

The twelve Ionian cities formed a sort of union, and their delegates periodically met at Panionion, on the slopes of Mount Mycale, to celebrate their games, which were managed by the neighbouring city of Priene. This was a loose bond, and did not prevent all intestine feuds, but it served to maintain a feeling of common origin and of common interest among the citizens of the twelve Ionian colonies. Another such bond was found in the worship of their goddess Artemis at Ephesus. This was an Asiatic divinity whose worship the Ionians found established among the original inhabitants when they arrived. It was a personification of the fructifying powers of nature, to whom the Greeks applied the name of their own goddess Artemis, combining with her worship that of her brother Apollo, the sun-god.

From a very early period these Ionians of Asia Minor were distinguished for the energy and ability with which they conducted their commercial ventures, and not less for their intellectual progress. Of the seven wise men of Greece, two, Thales and Bias, belonged to cities of the Ionian colonists. Thales predicted the solar eclipse which put an end to the battle between the Medes and Lydians, fixed the year at three hundred and sixty-five days, determined the course of the sun, and was the first to form a theory of the universe. He was a native of Miletus, as were his disciples Anaximander and Anaximenes, who were the first to measure time by a sundial. Heracleitus was a citizen of Ephesus, Xenophanes of Colophon, and Anaxagoras, who had an observatory on Mount Mimas, was of Clazomene. In later times, Samos produced more than one astronomer.

Led and helped by such brilliant intellects, the Ionian sailors soon covered the Ægæan with their ships, and began to venture on more distant voyages. Thales taught them to steer by the Little Bear like the Phœnicians, instead of the Great Bear,* while Anaximander gave them some idea of geography, and constructed maps and a celestial sphere. Their ships were enlarged and built on improved principles, and commerce enriched their cities. The invention of money is attributed to the Lydian kings, but the Ionian seaports were among the first to adopt its use. The electrum staters of Phocæa, and her smaller coins,

* Both were wrong. The star nearest the Pole in those days was α Draconis.

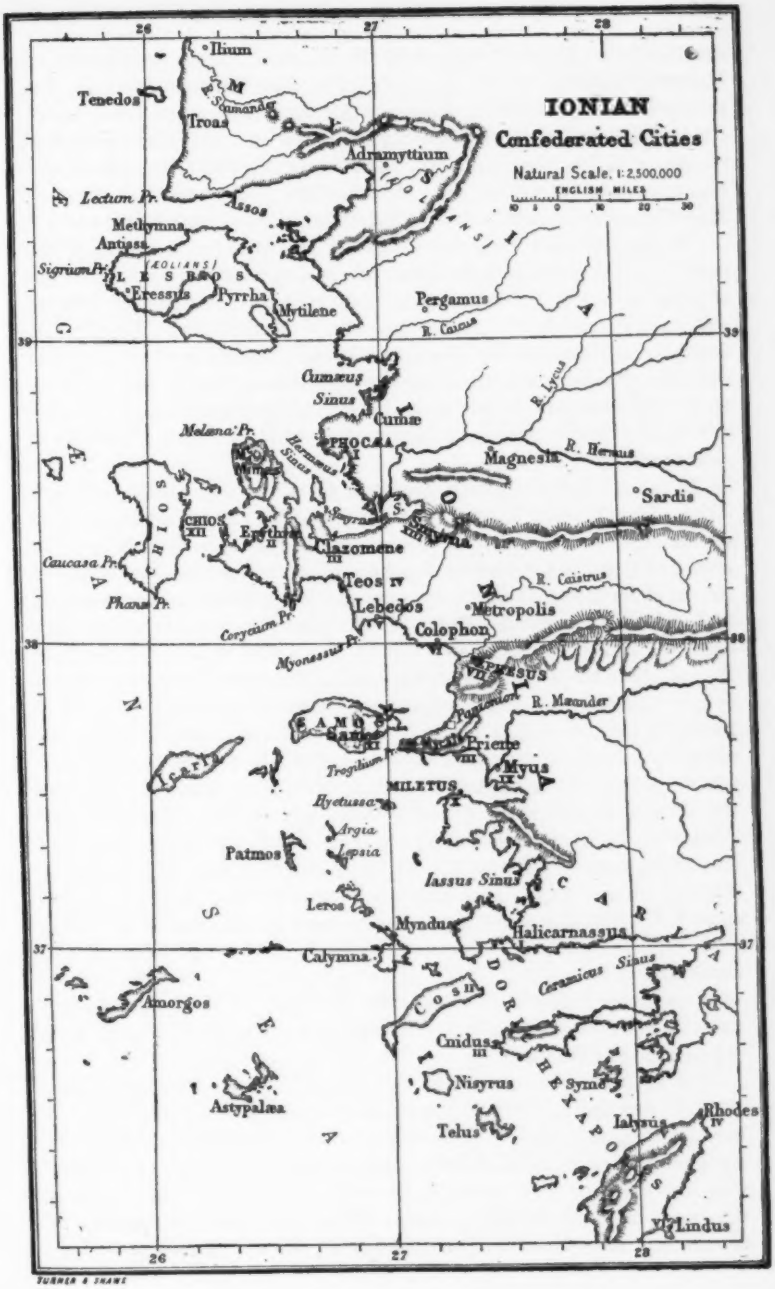
impressed, on one side only, with a seal or a seal's head, were circulated throughout the known world. The coin of Erythræ was stamped with a rose, that of Clazomene with a winged boar, Teos with a seated griffin, Chios with a seated sphinx, and Colophon with a lyre. Coins of the sacred city of Ephesus were stamped with a bee, the emblem of Artemis. The coin of Samos showed a lion's face, of Myus a bird, and of Miletus a lion or lion's head. Lebedos and Priene had no early coins, being small cities with little trade.

At different times Miletus, Samos, and Phocæa took the lead. Miletus, with her four harbours, enjoyed great prosperity, and established many colonies, chiefly on the Hellespont and in the Euxine. Abydos, Lampsacus, Cyzicus, Sinope, and Amisus owned her as their mother city. Samos, with her famous temple to Hera, was also a great maritime power under Policrates, and it was a Samian ship that first reached the eastern extremity of the Mediterranean,* B.C. 639. But it was Phocæa that held the supremacy of the sea for the longest time—from about B.C. 602 to 560.

Phocæa stood on a peninsula between the Cumæan and Hermæan gulfs, at a distance of about 20 miles north of Smyrna. The city possessed two excellent harbours, called Naustathmus and Lampter, and in front of them was the island of Baccheion, adorned with temples and other public buildings. Herodotus says that the Phocæans were the first Greeks who undertook distant voyages. Their sailors were acquainted with the Adriatic, the Tyrrhenian, and the Iberian Seas; and they were the first to visit Tartessus, a kingdom in the south of Spain, where the King Arganthonius was warmly attached to them, B.C. 639. This proves that the Phocæans undertook their expeditions without any predatory motives, and with the great objects of discovery and the extension of trade. Hence their relations with the people they visited were friendly and peaceful. They established a settlement at Alalia on the east coast of Corsica, in B.C. 566; but their great work was the foundation of the rich and powerful colony of Massalia (Marseilles) in B.C. 600.

When the Phocæans arrived on the south coast of Gaul, the country was ruled by a chief named Nannus. It was in about the year 600 B.C. when Euxenus, the Phocæan, opened friendly intercourse with him. The Grecian stranger was present at a banquet given by the Gaulish chief, when it was arranged that his daughter Petta was to give a cup of wine to the suitor she preferred. She presented it to Euxenus. They were married, and the lady received the Grecian name of Aristoxena, bringing the site of Massalia as her dower. Their son was named Protis, and the family of Protiadeæ flourished at least down to the time of Aristotle. Brought to the Grecian colonists by one fair

* 'Herodotus,' Melpom., iv. 5.



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Gaulish lady, Massalia was saved by another. Comanus, the son of Nannus, formed the design of seizing the place during a festival. His men entered the town in disguise, while he and a chosen band waited for a signal outside, the gates being all wide open. But a kinswoman of Comanus had a Grecian lover. She betrayed the plot to him, and Comanus was attacked and killed. Ever afterwards the gates of Massalia were closed when a festival was celebrated within the walls.

Warned by an oracle, the Phocæans had received a statue of the earth goddess from Ephesus, and with it they brought the first branch of olive to Massalia. Twin temples were raised to the Ephesian Artemis and the Delphian Apollo on the acropolis of the new city. The colonists formed settlements along the Gaulish and Iberian coasts, and while extending their commerce in all directions, they taught the Gauls in their neighbourhood to live under laws, to plant the olive, and to prune the vine. Cordial relations continued to exist between Phocæa, the mother city, and Massalia.

In the middle of the sixth century, a great calamity befell the Ionian cities. The Persian Empire, under Cyrus, was extended to the shores of the Ægæan, and most of the autonomous colonies had to submit, sooner or later, to the barbarian yoke. But freedom was the breath of life to the sailor princes of Phocæa. In B.C. 546 their city was closely besieged by Harpagus the Mede. Preparations were made for a desperate defence; and Arganthonius, King of Tartessus, the tried friend of Phocæa, gave large sums for strengthening the walls. At length, when longer resistance became hopeless, the Phocæans applied for a truce of twenty-four hours before surrendering, which was granted. They had collected a large fleet in the harbour. A noble resolution had been taken. The Phocæans actually carried out such a patriotic scheme as the Dutch meditated long afterwards, when their liberties were threatened by Louis XIV. Harpagus only demanded the demolition of one bulwark, and the dedication of one house in token of submission. But the Phocæans preferred exile to a home without freedom. They embarked with their wives and children, and their movable property. The descendants of such men were worthy to be the discoverers of the British Isles.

Teos alone followed the example of Phocæa. The other Ionian cities submitted after a brave struggle, and gradually sank into dependencies of Persia.

The fugitives, after resting at Chios, sailed away to their settlement at Alalia in Corsica. But they could only maintain their position there by exhausting sea fights with Etruscans and Carthaginians. Eventually a portion settled at Velia in Italy, while the bulk of the Phocæans were welcomed in their own colony at Massalia. Thus the distant city on the coast of Gaul became a second Phocæa, a second emporium of commerce, a second centre of maritime enterprise and discovery.

Massalia, the new Phocæa, was situated most advantageously for the prosecution of commercial enterprises by an intelligent and energetic people. It had an excellent harbour, a strong citadel, and the coasts of Spain and Italy stretched away on either hand, while its proximity to the mouths of the Rhone placed the internal trade of Gaul in the hands of the Massalians. It was not long before they had established trading-stations or settlements along the shores of the Mediterranean both to the east and to the west. To the east were Tauroentum, Olbia, Athenopolis, Antipolis the modern Antibes, and Nicæa, while far down in the south of Italy was the Phocæan colony of Velia. To the west were Rhodanusia at the mouth of the Rhone; Agatha near the modern Narbonne; and Rhoda, originally a colony of Rhodes, at the foot of the Pyrenees, the modern Rosas. Near Rhoda was the port of Emporium. On the modern Cape St. Martin in Spain, the Massalians had a temple of Artemis and a look-out station called Hemeroscopium, their town of Artemisia, the modern Denia, being at its base. The most western Phocæan trading-station, which was already a ruin in Strabo's time, was Mænaca, the modern Malaga.

Massalia soon became a rich and flourishing city, devoted to the worship of Artemis and Apollo, whose temples crowned the acropolis. The Phocæan emigrants traded peacefully to all parts of the Mediterranean, and continued their friendly relations with the people of Tartessus, even beyond the Pillars of Hercules. Their earliest coins were uninscribed divisions of the Phocæan drachma, and on their small obols of B.C. 350 they engraved a crab, symbol of Artemis, as protectress of harbours. One would have wished that the seal, the old coin of Phocæa, had been retained. It would have been specially appropriate for the Phocæan colony, one of whose sons was destined to bring to the knowledge of the world the first tidings of the Arctic Regions. But the seal disappeared. In its place was substituted a coin with the head of Artemis, and hair adorned with sprigs of olive on one side, and a lion with the letters MASSA (LIA) on the other. This coin became the chief currency in Gaul as far as Lyons and in the valley of the Po, and was copied by more distant Celtic tribes.

For the commercial relations of the Massalians extended their ramifications to far distant regions some of them unknown to the civilised world. Through their enterprise the countries of civilisation were supplied with rare products, the origin and sources of which, in some cases, were unknown. Especially was this the case with tin, the Κασσίτερος of the Greeks. Unmentioned in the 'Odyssey,' the name occurs as a white and shining metal in the 'Iliad,' used as ornaments for arms and chariots. Herodotus had heard of the regions whence tin was brought, as the *Cassiterides*, but he knew nothing about them. The Massalians knew this much more than Herodotus, that tin and amber were brought from a distant country far to the

north, to their station at the mouth of the Rhone, by Gaulish merchants. Naturally the enterprising Phocæans desired to know more. They were explorers and the descendants of explorers. It would be an easy transition from the wish for knowledge, to the resolution to attain it. We thus come to a consideration of their expeditions beyond the Pillars of Hercules, and to the achievements of their great explorer Pytheas.

The Carthaginians, in about 500 B.C., had sent two expeditions beyond the Pillars of Hercules, one under Hanno to go south along the coast of Africa, the other under Himilco northwards in search of the tin country. Of course the despatch of Himilco implies that voyages had previously been made through which the country of tin mines had become known, but such voyages were made by the sailors of Tartessus in the south of Spain. Himilco described Abyla and Calpe, and then a lofty promontory called Œstrymnis, opening on the Œstrymnic Gulf. Here his voyage appears to have ended, Œstrymnis being Cape Finisterre in Spain,* and the gulf answering to the Bay of Biscay. He heard of islands called the Œstrymnides scattered widely about, rich in tin and lead, and inhabited by active traders navigating in vessels of skins. Thence it is two days' sail to the Sacred Island near the Island of Albion. The names given by Himilco occur nowhere else. He was told that the people of Gades (Tartessus) traded with the Œstrymnides,† but the voyage was made with difficulty in four months, the wind often failed, monsters of the deep swam to and fro, and sea-weed hampered the progress of the ships. This hearsay information was of little or no value. But, whether useful or worthless, it is certain that the Carthaginians kept it secret, and that the Greeks of Massalia had never heard of the voyage of Himilco.

Any discovery beyond the Pillars of Hercules by the Phocæans of Massalia must have been achieved by their own unaided efforts, without guidance from the experience of Himilco or any other foreign navigator. Fortunately, the colony possessed a man eminently fitted to conduct an exploring expedition, in the person of Pytheas, the mathematician and astronomer. It is alleged by Polybius that Pytheas was in poor circumstances, and we may, therefore, conclude that the enterprise was a government expedition of which Pytheas was placed in command. The nearest approximation we can get to its date is the time of

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* Mr. Elton holds that Œstrymnis is Cape St. Vincent, and that the Œstrymnides represent Madeira and Teneriffe: pp. 15, 22.

† According to Posidonius tin was found among the Artabri, the modern Galicia in Spain. This may be the source whence came the tin of Gades and the Phœnicians; while all the British tin was brought through France to the mouth of the Rhone. The 'Œstrymnides' would then be a fable of Himilcar (see 'Bunbury,' ii. p. 89); and 'Cassiterides' seems to have been a vague general term for the source of the tin trade, originated by Herodotus.

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Alexander the Great and Aristotle,* about B.C. 330, and we may well suppose that the object was the discovery of the countries whence came those rare and valuable products which reached the Massalians by a long overland route and a descent of the Rhone.

Pytheas prepared for his perilous undertaking by carefully fixing the latitude of Massalia as a point of departure. His pre-eminence in his own day will be obvious when we recollect that he lived before the principal Greek astronomers, Eratosthenes and Hipparchus, and that none of his predecessors had demonstrated the methods which he adopted. The earliest way of calculating the distance of a place from the equator was by observing the length of the longest and shortest days The ancient geographers divided the Earth into parallel zones, within which the longest day had a certain length, generally an hour: one zone from twelve to thirteen hours, the next from thirteen to fourteen, and so on. The zones were called "climates," from the Greek word *klima*, a slope or inclination. They were unequal in width, the zone in which the longest day was from fourteen to fifteen hours being 600 miles in width; while the zone in which the longest day was from nineteen to twenty hours has a width of only 125 miles. Pytheas used this system during his voyage; but in fixing the latitude of Massalia he adopted a more accurate method.

The Phocæan astronomer erected a large gnomon at Massalia,† divided into one hundred and twenty parts. He observed its shadow at noon on the day of the solstice, and found that its length was forty-two of the parts on the gnomon, less one-fifth—that is, forty-one and four-fifths to one hundred and twenty, or two hundred and nine to six hundred. This proportion gave 70°. 47′. 50″ for the altitude of the sun. The length of the longest day was fifteen hours fifteen minutes. Eratosthenes and Hipparchus found the obliquity of the ecliptic to be 23°. 51′. 15″,‡ which they deducted from the altitude. The complement of the result was the latitude of the place less the semi-diameter of the sun, namely, 43° 3′ 25″. With the semi-diameter added, the result is almost exactly the latitude of the Marseilles observatory.

Another important point was to fix upon the nearest star to the pole as a guide for steering the ship. Pytheas found that there was no star on the pole, but that there were three very close to it.§ These would have been β Ursæ Minoris and α Draconis in those days; and Pytheas used one of these as his pole star.

It is probable that there was no other man, in the days of Alexander the Great, who could have prepared for a voyage of discovery by fixing

* The work of Pytheas was known to Dicæarchus, who was a pupil of Aristotle. The date of the voyages must, therefore, have been not later than the time of Aristotle.

† 'Cleomedes ap Lelewel,' p. 49.

‡ 'Eratosthenes ap Ptolemy Almag,' i. 2; 'ap Lelewel,' p. 49.

§ "Hipparchus in Arati phænom," I. 5, from 'Lelewel,' p. 48 (*n.* 121).

the exact latitude of his point of departure, and by selecting correctly the star by which he should shape his course. For the rest, his countrymen were well able to furnish him with a serviceable vessel. From the temples of Artemis and Apollo in the citadel it was a short descent over rocky ground to the harbour, which, like the city, was protected on the land side by a strong wall. Here were the *νεώσοικοι*, or docks, and the armoury, or arsenal, called *ὁπλοθήκη*. A large Massalian ship was a good sea-boat, and well able to make a voyage into the northern ocean. She would be from 150 to 170 feet long—the beam of a merchant ship being a quarter, and of a war-ship one-eighth the length—a depth of hold of 25 or 26 feet, and a draught of 10 to 12. Her tonnage would be 400 to 500, so that the ship of Pytheas was larger and more seaworthy than the crazy little *Santa Maria* with which, eighteen hundred years afterwards, Columbus discovered the New World.

A Grecian ship was strongly built on regular principles, commencing from the *τρόπις*, or keel, a horizontal beam which in the older ships rose from the centre in a curve. Under it was the *κέλευσμα*, or false keel, and above the *δρύοχον*, or keelson. The stem (*στεῖρα*) and stern-post were inserted on the keel nearly at right angles, and from the keel also rose the ribs (*ἐγκοίλια*), connected and strengthened by cross-beams (*στρωτήρ*). The upper deck, or *κατάστρωμα*, had bulwarks made of trellis-work. In large ships there was a lower deck, or *ἔδαφος*, above the hold (*κοῖλον*), with a second set of cross-beams (*ζυγόν*). The prow (*πρῷρα*) and poop (*πρύμνα*) were raised above the upper deck, and had half-decks, called *ἐκρίωμα*. The bow and stern were both pointed and identical in construction, the stem and stern-posts both ending in a volute, or the neck of a swan. But the bows were fitted with a beak or ram, level with the water-line, consisting of rafters let into the body of the vessel, and ending in a point shod with iron, in three blunt teeth. Two beams, supported by props, protruded from both sides of the beam. The hawse-holes on each side of the stern were bound with iron, and were called *ὀφθαλμοί*, or eyes.

The Grecian ships were further strengthened externally by a wooden ledge along the water-line, and also by four stout hawsers, called *ὑποζώματα*, passed round the hull below the water-line. Boards were placed over the ribs inboard. On the poop there was a tent-like house for the pilot and helmsman called the *σκηνή*, and there were two oar-like rudders or *πηδάλια*, on each side of the stern-post, which were worked by a tiller-rope, called *χαλινός*, running across the vessel, the rudders always being kept parallel. The mainmast, or *ἱστὸς μέγας*, was stepped in the centre of the ship, and fitted with yards to which square sails were laced—a mainsail, maintopsail, topgallant sail, and even a triangular royal. The mast had stays (*πρότονοι*), backstays (*ἐπίτονοι*), and shrouds (*καλοί*). There were two smaller fore and after masts with

lateen sails, used for paying her off or for putting her up into the wind. The upper deck was covered with an awning, in fine weather, called *κατάβλημα*, where a flagstaff was also raised (*στηλίς*) with a flag (*σημεῖον*).

The rowing-power of ancient galleys, supplementary to the sails, has been looked upon as the equivalent to the steam-power of modern times. In the Grecian ship there was a narrow gangway on both sides, called *πάροδος*, lower than the upper deck, and just above the rowlocks for the upper tier of oars. The rowing apparatus, or *ἔγκωπον*, was in the centre part of the ship, and the space for the *ἐρέται* or rowers was called *ζύγωσις*, the bench itself being *ζυγά*. The distance between the rowers was 4 feet, and in a large trireme there were fifty-four *θαλαμίται* or bottom rowers, fifty-eight *ζυγίται* or middle, and sixty-two *θρανίται* or upper rowers, making one hundred and seventy-four all told. The oars for the *θαλαμίται* were 7½ feet long, and the length had to be increased by 3 feet in each ascending row. The oar (*κώπη*) passed through a circular *τρῆμα* or rowlock, which was covered by a tarpaulin when not in use. The sailors or rowers were of course much more numerous than the *ἐπιβάται* or marines. The *κελευστής* or officer in command of the rowers had a lieutenant (*ἐπόπτης*), and not the least important person on board was the *τριηραύλης* or piper, by whose music the rowers kept time.

The anchor (*ἄγκυρα*), as shown on the most ancient coins, had two flukes, and a shank with a ring at the end for the cable. In some anchors there was also a ring at the meeting of the flukes, to raise or turn them if they had not caught the ground. The cable (*σχοινία ἀγκυρεῖα*) was worked by a *στροφεῖον* or capstan; and for going on shore there were boat-hooks (*κοντοί*) and gang-boards (*κλιμακίδες*).*

In the days of Alexander, a voyage of discovery beyond the Pillars of Hercules was as bold and daring a conception, as was a voyage in search of the Indies by the western route, in the days of Ferdinand and Isabella. We have seen that Pytheas, the first of the great explorers, like the illustrious Genoese of later times, prepared himself for his difficult task by long and patient study of the astronomical bearings of the question. Thus well-provided with all the knowledge of his time, he raised his anchor,† and commenced his coasting voyage towards the Sacred Promontory,‡ the western limit of the known world. The Grecian ships were supposed to make an average of about 500 *stadia* or 50 miles in a day's sail, the *stadium* being the unit of measurement for all geographical distances.§ Coasting along near the shore, the ship of

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* This account of the structure and fittings of a Grecian ship is taken from the work of E. Guhl and W. Koner, translated by Hueffer, 'Life of Greeks and Romans.' Chatto & Windus: 1877.

† In the end of December, according to Lelewel, p. 35.

‡ Cape St. Vincent.

§ Colonel W. Martin Leake contributed a valuable paper on the stadium as a linear measure to Vol. IX. of the Society's *Journal*. The original stadium was the length

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Pytheas would first have come to the Massalian settlement at the mouth of the Rhone, and then to Rhoda and Emporium (the modern Ampurias) in the beautiful bay of Rosas, at the base of the Pyrenees. Next the temple of Artemis, crowning the lofty promontory now dedicated to St. Martin came in sight, where the Massalians had their *Hemeroskopion* or look-out station. There was a settlement called Artemisia (the modern Denia) at the foot of the heights, where the explorers could anchor and find rest. The last friendly haven would be at Mænaca, the modern Malaga. Sailing through the Straits of Calpe, the Greek mariners would scarcely venture to stop at Carthaginian Gadeira, although, in times gone by, the native ruler of the country had been on such cordial terms with Phocæa. But the cruel Semites since established at Gadeira were enemies of western civilisation, and Pytheas sailed slowly on to the Sacred Promontory, the end of the known world, very slowly, for the 48 leagues from Cadiz to Cape St. Vincent took him five sailing days.

Pytheas continued his coasting voyage to the north as far as Œstrymnis (Cape Finisterre), the probable furthest point of Himilco, then eastward along the north coast of Iberia, and round the Bay of Biscay. His narrative is lost, but we gather that he described the coasts of Iberia, made valuable observations respecting the tides, and furnished information touching the best way of passing from Iberia to Celtica or Gaul. "He had acquired a practical acquaintance of the navigation along the north coast of Spain." His first recorded observation on the voyage had for its result that the longest day was fifteen hours, which would be in lat. 40° 59′ off Oporto.

Pytheas found that the north-western part of Gaul formed a long promontory called Calbion, the country of a tribe called the Ostimii, which stretched far to the westward. He even thought that it extended for 2000 *stadia* to the west of Cape Finisterre of Spain. But great allowances must be made for errors in longitude at a time when no means were known of estimating it, beyond guess-work. He mentions an island off the coast called Uxisama, evidently intended for Ushant. A second observation is given of sixteen hours for the length of the longest day, equal to 49° N., which is within 30 miles of the latitude of Ushant. The explorer left the north coast of Gaul, and shaped a direct course for a part of Britain which he called Cantion (Kent), the Cantium of Cæsar. This must have been the route, because he reported that the coast of Gaul, where he left it, was some days' sail from Cantion.

The Cantion of Pytheas was doubtless the modern Kent, although it

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of the Olympic foot-race, equal to 600 Greek feet. The Greek foot, deduced from the stylobate of the Parthenon, is equal to 12·1375 English inches. This gives $8\frac{7}{10}$ stadia to a statute mile, 10 stadia to a geographical mile, and 600 stadia to a degree. A stadium was also $\frac{1}{8}$ of a Roman mile, equal to 625 Roman feet; and a Roman foot was 11·65 English inches, which gives the same result.

may be intended to include additional territory to the north. Here he stopped; and we are told that he not only landed, but travelled over a part of Britain on foot. He probably went westward to collect information respecting the tin trade, which in those days would have entailed a very difficult and perilous journey.*

Britain, in the third century before Christ, was almost in a state of nature. The valleys were covered with primeval forests, their lower parts were occupied by vast swamps, and it was only on the downs and hill ranges that there were *Gwents*, or open clearings. Still the Keltic tribes had been in possession for several centuries, and had made some advances in civilisation. They brought domestic animals with them, raised wheat and other cereals, and had iron tools and arms, wooden chariots with iron fittings, and ornaments of bronze and gold. Pytheas saw and made note of the farming operations and way of living among the natives of Cantion (Kent). Between this south-eastern district and the Gwent now comprising the downs of Wiltshire and South Hampshire there was the great forest of Anderida, extending from Hampshire to the Medway. Pytheas would have to pass this forest on his way to the western part of Britain (the present Cornwall), which was called *Belerion*.† Here he found the country of the tin, which was dug out of the ground in mines with shafts and galleries. The people were very hospitable, their commerce with foreign merchants having civilised them and softened their manners. The metal was carried by them in six days' journey to an island called Ictis (St. Michael's Mount), whence the traders from Gaul conveyed it across the Channel, and down the Rhone to Massalia. "This island is described as surrounded by the sea at high water, but connected with the mainland by a tract of sand left bare at low water, so as to render it a peninsula to which the tin was carried in waggons."‡ Pytheas no doubt gave a stimulus to this trade, and was probably the first to introduce coined money into Britain. After the discovery of the gold mines of Crenides, in 356 B.C., Philip of Macedon produced £250,000 worth of gold coin a year. The beautiful stater of Philip was everywhere diffused. It soon reached Massalia, whence it was circulated inland, and it was seized on by the Gauls as an object of imitation in about B.C. 300. Pytheas may well have

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* If the account given by Diodorus of Belerion, Ictis, and the tin trade is, as is more than probable, taken from Timæus, it was derived from the work of Pytheas. In that case the journey on foot through Britain must have been to Belerion, and the coast opposite Ictis.

† Ptolemy has *Bo*lerium for the Land's End. Posidonius seems to have been the first to use the name *Belerion* for the tin country.

‡ *Mictis* of Pliny, and *Vectis* of Ptolemy. Mr. Elton thinks it was Thanet (p. 34). Sir E. Bunbury considers that there is no reasonable doubt that it was St. Michael's Mount to which the description precisely answers. (II. p. 197) Ptolemy gave the name of Vectis to the Isle of Wight.

brought the first staters of Philip to Britain, thus introducing the use of money. They were afterwards roughly imitated by the natives; but no British coin has an earlier date than B.C. 200.

Several pieces of information respecting the natives of Britain, related by Pytheas, have been preserved. In consequence of the rain and absence of sun, the former did not use threshing-floors, but threshed their corn in large barns. They stored the ears of corn in pits underground, and the part that had been longest in store was brought out daily and prepared for food. They made a fermented liquor from barley, which they used instead of wine; it was called *curmi*. As Columbus was the discoverer of tobacco, so his great predecessor, Pytheas, discovered beer. Pytheas also says that the Britons made another drink from honey. Their houses were of wood and thatch, and he mentions the war-chariots, but adds that the chiefs were generally at peace with each other. He believed the people to have been *autocthones*, or aborigines.

When Pytheas returned to his ship, in some haven of Cantion, he proceeded northwards along the coast of Britain; and his next observation gave seventeen hours as the length of the longest day. This would be in lat. 54° 2′ N., somewhere in the neighbourhood of Flamborough Head. Still coasting to the north, in his great voyage of discovery, he reached a point at the northern end of Britain where the length of the longest day was eighteen hours. The corresponding latitude is 57° 58′ 41″ N., which is that of Tarbett Ness, in Ross-shire. As he advanced to the Pole he found that the cultivated grains and fruits, and almost all domesticated animals, gradually disappeared. The people in the far north were reduced to live on millet, herbs, and roots. The intrepid explorer still pushed onwards to discover the northernmost point of the British Isles. Coasting along the shores of Caithness and the Orkney Islands, he finally arrived at a land where the length of the longest day was nineteen hours. This was in lat. 60° 51′ 54″ N., in Burra Fjord, on Unst Island, the northernmost of the Shetlands. Pytheas gives the name of *Orcas* to this extreme point of the British Isles—a name which in later times was transferred to the Orcades, or Orkney Islands. It was doubtless a native name.

It was at Orcas that Pytheas received information of an Arctic land called *Thule*, at a distance of six days' sail, and near the frozen ocean. Here the summer tropic and the Arctic circle are all one, that is there is no night at the summer solstice and the latitude would be 66° N.* Thule may either have been Iceland, or the coast of Norway in the neighbourhood of Alstenoe and Vitsen-fjord. Pytheas does not say that

* He heard also that, during one season the night was continuous, and during another it was continuous day, 'Cosmas Indicopleustes,' ii. 149, and 'Geminus,' v. 22; ap 'Lelewel,' p. 37.

Thule was an island, nor that he visited it.* It is more likely to have been Norway, because Iceland was unvisited and unknown until long afterwards. The word Thule, in the forms Thyle, Thul, Tell, is ancient Saxon, meaning limit. Telle-mark is in Norway. Pytheas also received reports of the physical aspects of the region beyond Thule. His account has been turned into nonsense by 'Strabo,'† copying from the explorer's bitterly hostile critic Polybius. Yet even as we have it, the account is a good description of a dense fog at the edge of the pack, amongst sludge ice, which "can neither be travelled over nor sailed through." He might have seen such ice occasionally, at no great distance from the Shetlands.

Pytheas was thus not only the discoverer of Britain, but the first explorer who received information respecting the Arctic Regions. He was, as Professor Rhys has truly said, "one of the most intrepid explorers the world has seen." If, as we may infer from their approximate accuracy, the five observations for the length of the longest days were taken by the explorer himself,‡ the voyage must have occupied about six years. Sailing southwards from Orcas, Pytheas returned to Cantion, and continued the long voyage onward to Massalia, whence he soon set out on another expedition to examine the coasts of the continent from Gades to a river called the northern Tanais.§

Coasting round the Bay of Biscay, and along the coast of Gaul, as in the previous voyage, Pytheas continued to hug the continental shore instead of crossing to Britain. He passed the mouths of the Rhine, where the Ostioni dwelt, and entering the Gulf of Mentonomon, reached a river which he called the Tanais. The gulf appears to have been the bay formed by the coasts of Schleswig-Holstein on one side and Friesland on the other, and this northern Tanais is identified with the Elbe.‖ The shores were inhabited by a tribe called Guttones. He

* Mr. Elton thinks that Pytheas sailed north of the Loffoden Islands to the North Cape (p. 67); but Sir E. Bunbury, in spite of a doubtful passage in Cleomedes, is inclined to the view that the explorer did not himself visit Thule.

† 'Strabo,' i. 157. "'Neither earth, water, nor air exist separately, but a sort of concretion of all these' (resembling marine sponge), 'in which the earth, sea, and all things were suspended' (thus forming as it were a link to unite the whole together). 'It can neither be travelled over nor sailed through.' (As for the substance, he affirms that he has beheld it with his own eyes; the rest he reports on the authority of others.)" The sentences in parentheses are probably interpolations of the critic.

‡ I cannot think, with Lelewel, that Pytheas merely obtained the length of the longest days from statements of natives.

§ Sir Edward Bunbury, M. Lelewel, and Mr. Elton, think that Pytheas did not return to Massalia before undertaking his second voyage, but that he sailed to the continent from Cantion, so that there was practically only one voyage. But the writer of the article 'Pytheas' in Smith's 'Dictionary of Greek and Roman Biography,' is of opinion that "the words are scarcely susceptible of such an interpretation," and holds that there were two distinct voyages.

‖ Timæus says that the Argonauts went up the southern Tanais (Don), transported their boats overland, and went down the northern Tanais (Elbe).

was here told that, at a distance of a day's sail, there was an island called Abalon or Abaleia,* where the amber (*electrum*), which is an excretion of the condensed waves, is carried by the sea on to the shore, in the spring. It is used for fuel by the islanders, and was also sold by them to their neighbours the Teutones, through whose trading ventures it eventually reached Massalia, and became an article of commerce in the marts of the civilised world. Abalon was probably the western coast of Schleswig, whence a supply of amber used to be obtained, and perhaps this was also a trade route for the more distant sources of amber supply in the Baltic.

Pytheas lived to return to Massalia once more, and to write one, if not two books, describing the events and results of his memorable voyages. The work entitled 'On the Ocean'† is believed to have referred to the expedition to the British Isles; while the 'Periplus'‡ described the second voyage to the mouth of the Elbe. Both are unfortunately lost to us.

We know, from his observation at Massalia, that Pytheas could fix a latitude within a few minutes, when the declination and sun's semi-diameter are applied to the result. It is, therefore, logical to credit him with knowing where he was when he observed and recorded the length of the longest day on five different occasions. An opposite plan has been adopted by some critics. They first settle where he was, and then decide that his latitude was 100 miles out. For instance they first settle that the Orcas of Pytheas was Duncansby Head in 58° 39′, and then condemn him for putting Orcas in 60° 50′. A more logical course would be to assume that Orcas was in 60° 50′, and that consequently it could not be Duncansby Head, but that it must be a place in the latitude indicated by Pytheas. The distances in *stadia* and *day's sail* with which Pytheas is credited by Strabo must either be deductions by Eratosthenes and others from the data of Pytheas, or else corrupt readings. Most of them are preposterous, and in neither case can Pytheas be fairly made responsible for them.

We may now estimate his place among explorers. The Ionians of Phocæa and Massalia had been trained as daring mariners and thoughtful students for generations, alike in the mother city and in the colony; and all their admirable qualities seem to culminate in the life-work of Pytheas. His learning and his discoveries form the fitting crown of their history. The seal on the coins of Phocæa, and the lion on the coins of Massalia appear as emblems of the Arctic Regions and of the British Isles. In the fulness of time the cities which owned those emblems produced a son, who, through his great knowledge and intrepid

* Called "Basilia" by Diodorus, following Timæus.

† Περι του Ωκεανου. 'Geminus. Elem. Astron. in Petav Uranol,' p. 22.

‡ Περιπλους. 'Marcianus in Geog. Min.,' i. 63, and 'Scholiast on Apoll. Rhod.,' iv. 761. References in Smith's Dictionary, art. 'Pytheas,' and in Lelewel, p. 25.

daring, became the discoverer of Britain, and the first bearer of tidings respecting the Arctic Regions. Pytheas was a geographer and an explorer in the highest sense. For he must have devoted long years to qualify himself for his great task, and his work had placed him in the first rank of nautical astronomers before he undertook his voyages into the unknown ocean. His learning, and the perilous character of his enterprise, make him comparable with Columbus, while Englishmen may well deem that his discovery was, beyond all comparison, the most important that any explorer has ever made.

In connection with the lamentable destruction of so many precious works of antiquity, one of the strangest things is the way in which fragments and scraps, which, from the loss of so much else, become of infinite value, have been drifted down the stream of time on to our distant shore. About the voyage of Himilco we should know nothing but for the chance of a poet of the fifth century having embodied notices of it in his verses, and for the still greater chance that some of these verses happened to escape destruction.* The chances by which our slight knowledge of the work of Pytheas have reached us are still more remarkable. The accounts of his astronomical observations, and of his voyages of discovery, necessarily attracted much attention from his contemporaries; and although Dicæarchus is said to have rejected some of his conclusions, they received fair treatment from the great astronomers Eratosthenes and Hipparchus; and his works were largely used by the historian Timæus, who was his contemporary. On the other hand Polybius condemned Pytheas as unworthy of belief, apparently because the discoveries of the man of action conflicted with the preconceived ideas of the theoretical geographer. Polybius flourished two hundred years after the time of Pytheas. He criticised Eratosthenes and Hipparchus severely for accepting the statements of the great Massalian astronomer and explorer.

Even though the books of Pytheas are lost, if we could have seen the comments of his critics, both favourable and hostile, we should have been able to gather a great deal more than we now know respecting his life-work. But the works of Eratosthenes, Hipparchus, and Timæus are also lost, and the attack of Polybius on Pytheas was contained in his missing books. Strabo, the geographer, like Polybius, was fond of criticising the work of his predecessors. He lived three hundred years after the time of Pytheas, but he adopted all the prejudices of Polybius, and his method caused him to make copious extracts, not only from Polybius, but also from Eratosthenes and Hipparchus respecting the work of their Massalian predecessor, with a view to its disparagement.

* 'Ora Maritima,' describing the coast from Massalia to Gades, by Avienus Rufus Festus, who is believed to have flourished in the end of the fourth century A.D. It contains some extracts from a work on the voyage of Himilco, which is not quoted nor mentioned by any other writer. The voyage itself is just mentioned by Pliny.

It is from these extracts in Strabo that our knowledge of Pytheas and his voyages is mainly derived.

We have to choose between Eratosthenes and Hipparchus on one side, and Polybius and Strabo on the other. The illustrious astronomers were men with a scientific training, earnest searchers after truth, and capable of weighing evidence. Strabo, like Polybius before him, was intolerant of any statement which ran counter to his preconceived ideas. He would not have believed the god Hermes himself if he told him that he had been to the ends of the earth, much less "that charlatan Pytheas." His other argument is that "the veracity of a writer who has been false in describing countries with which we are well acquainted should not be too much trusted in regard to unknown places." This is true enough. Strabo, however, gives no instance of Pytheas's want of veracity respecting well-known places. But the criticisms of Pytheas by Strabo are satisfactorily disposed of by the fact that whenever Strabo specifies a falsehood or a blunder of Pytheas, the explorer is approximately right, and the theoretical geographer is wrong. If Strabo had treated the statements of Pytheas with the respect they deserved, instead of calling him a liar, his own ideas would have been more correct. He would not have placed Ireland to the north of Britain. He would not have expunged the peninsula of Brittany from his map. He would not have placed the north coast of France in the latitude of Bordeaux. As between Pytheas and Strabo, there can be no question now as to which of the two was the more correct geographer. Still we must be grateful to Strabo for having preserved nearly all we know of Pytheas, without looking too closely into his motives. Strabo fully acknowledges the merits of Pytheas as an astronomer and mathematician, and commends the accuracy of some few of his statements. Although the history by Timæus is lost, Diodorus Siculus, and Pliny, in his natural history, have handed down to us a few precious extracts from it, relating to the work of Pytheas.

It is in this curious way, chiefly indeed through the desire of Strabo to discredit his narrative, that the few particulars respecting the voyages of Pytheas have been passed down to us. They are all contained in the works of Strabo, Diodorus Siculus, and Pliny.*

The voyages of Pytheas have received much attention from the scholars of Germany† and France,‡ but I believe only two have

* In reading the works of these three authors I have used 'Geography of Strabo,' translated by Hamilton (Bohn ed.); 'Bibliothèque Historique de Diodore de Sicule. Traduit par Miot' (Paris, 1834); 'Histoire Naturelle de Pline. Traduction par Ajasson de Grandsceque' (Paris, 1833).

† Fuhr, 'De Pytheæ Massiliensi dissertatio' (Darmstadt, 1835). Brückner, 'Historia Reipublicæ Massiliensium.' F. A. Ukert, 'Geographie der Greichen und Romer' (Weimar, 1816–43, 5 vols.). Redslob, 'Thule: die Phonicischen Handelswegen nach den Norden' (Leipzig, 1855). Bessel, 'Pytheas von Massilien' (Gottingen, 1858).

‡ D'Anville, 'Mémoire sur la navigation de Pythéas à Thule' (Mém. de l'Académie

adopted the views of Strabo; Gosselin * in France and Sir George Cornewall Lewis † in England. The grounds of the unbelief of Gosselin are that Pytheas omitted to mention certain things which his critic considers that he must have mentioned if he ever made the voyage.‡ As the books of Pytheas are lost it is as impossible for Gosselin to affirm that he did not mention these things as it is for the advocates of Pytheas to say that he did. But these imaginary omissions in a lost book supply no valid argument against the authenticity of the voyages. Pytheas probably did mention all the points enumerated by Gosselin.

The reason given by Sir George C. Lewis for concurring in the hostile judgment of Strabo was that he believed he had found the false statement of Pytheas in describing countries with which Strabo was well acquainted, to which that geographer referred without specifying it. Sir George C. Lewis found the offending assertion in one of the 'Scholia of Apollonius Rhodius.'§ There Pytheas is alleged to have said that if any person placed a piece of iron at the mouth of Stromboli with some money, he found in its place, next morning, a sword or any other article of iron he wanted. Stromboli, like Ætna, was supposed to be the workshop of Vulcan. He also said that the surrounding sea was once in a boiling state. It is not alleged that Pytheas asserted these things of his own knowledge. He very properly repeated the interesting myths that he had heard in his travels, and this practice, while adding to the value of his work, does not in the slightest degree justify a doubt of his own accuracy and good faith.

The general, indeed the almost universal opinion of scholars who have recently investigated the question is that Pytheas is worthy of credit, and that his voyages are authentic.‖ Sir Edward Bunbury may be accepted as the highest and most reliable living authority on this

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des Inscrip. et Belles Lettres, tom. xxxvi., 436). Gassendi, 'Opera' (iv., 530). Bougainville, 'Eclaircissemens sur la vie et les voyages de Pythéas" (Mém. de l'Académie, tom. xix.).

* P. F. J. Gosselin, 'Recherches sur la géographie systématique et positive des Anciens' (1798–1813, 4 vols.). J. Lelewel, 'Pythéas de Marseille et la géographie de son temps' (Bruxelles, 1836). Aout, 'Etude sur Pythéas' (Pamphlet, Paris, 1866).

† Sir G. C. Lewis, 'Historical Survey of the Astronomy of the Ancients' (8vo, 1862.)

‡ "How explain his silence about the Cassiterides? Why, when he speaks of Thule, does he say nothing of the Orcades? How did he make a mistake of 2½° in latitude in the extreme north of Scotland, when he had observed the latitude of Marseilles so well? Why did he not mention the tin trade with the Timii? Why does he not describe the bay between Cape Sacré and Calbion? Why does he say the tide ceases at Cape Sacré?"

§ The reference of Sir G. C. Lewis is to 'Schol. Apollon. Rhod.,' iv. 761; 'Schol. Callim. Hymn Dian.,' 47.

‖ Smith's 'Biographical Greek and Roman Dictionary,' art. Pytheas; Sir E. H. Bunbury, 'History of Ancient Geography' (1879); Charles T. Elton, 'Origins of English History' (1882; second edit., 1890); Professor Rhys, 'Celtic Britain' (1884).

subject. The late Professor Freeman used to say that he always felt perfect confidence in any article under which he saw the initials E.H.B. Sir Edward's decision is that Pytheas really made the voyage, and that he brought back much useful information. We may, therefore, accept as an established historical fact, that Pytheas of Massalia obtained the first information respecting the Arctic Regions, and that he was the discoverer of the British Isles.

A JOURNEY FROM THE SHIRE RIVER TO LAKE MWERU AND THE UPPER LUAPULA.*

By ALFRED SHARPE.

On July 21st, 1892, I left Zomba and reached Mpimbi on the Upper Shiré the same day, and was there joined by Mr. John Kydd, who accompanied me on my journey. From Mpimbi we went up the Shiré River by boat to Fort Johnston, where we found the ss. *Domira*, and shipped our goods on her for Karonga.

On August 1st we left Fort Johnston in the *Domira* for the north, taking twenty-nine Zanzibari police as an escort; also one donkey. While at the Fort I took observations for latitude, the result of which was 14° 25′ 46″ S. On August 4th we reached Bandawe, and there recruited carriers for the journey. I succeeded in getting one hundred and ten men, and with these we went on in the *Domira* to Karonga, where we arrived on the 11th. At Bandawe I took observations for latitude which placed the Mission Station in 11° 53′ 36″ S. The calculations for all the observations taken by me throughout my journey are enclosed herewith. On Lake Nyasa I worked for latitudes with the meridian altitude of the sun. After leaving Karonga I used the stars Vega, α Pavonis, and α Gruis.

At Karonga I had the opportunity of purchasing a steel section-boat, one which Captain Stairs had brought with him on his expedition and sold to the African Lakes Company at Karonga. It subsequently proved invaluable to me. On August 21st I reached the African Lakes Company's "Fife" Station, half way across to Lake Tanganyika. This station, which includes a population of four or five hundred natives, is surrounded by a stockade, a bank, and a deep ditch, and is impregnable to any attack by natives or Arabs. This place is on the north-eastern borders of the Awemba country, and Mr. McCulloch (who is in charge of the station) has succeeded in opening up friendly relations with several of the important Awemba chiefs, who had hitherto kept out of all dealings with us (the English), and endeavoured to close their country to us. The Awemba have always been urged by the Arabs to

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* Map, p. 576.

keep their country closed to the whites. This is because it is one of the great sources of supply of slaves. All the people caught by the Awemba in their constant raids are sold to the Arabs. On my journey two years ago to Mshidi's and Katanga, I passed across the Tanganyika road, and at that time the West African "jigger" (*Sarcopsyllus penetrans*) had just made its appearance on the south end of Lake Tanganyika. On my present journey I found that it not only was quite plentiful now at Tanganyika, but had crossed the plateau and reached Nyasa. At Karonga and at all the villages on the road to Tanganyika jiggers (locally called "Matakenya") have become a pest. Doubtless before long they will reach Blantyre and the east coast. On August 25th I called at the French Mission Station at Mambwe, and was very hospitably and kindly treated by Father Van Oost, the missionary in charge. On August 29th I called at the Fwambo Station of the London Missionary Society, in charge of Mr. Jones. This place is also protected by a stockade, a bank, and a ditch, and is very strong. It has a population of some three to four hundred people, who have settled with the missionaries for protection.

On August 30th I arrived at Abercorn Station on the southern shore of Lake Tanganyika. Mr. Kydd had on this day the misfortune to fall into a game-pit, and his thigh was pierced by a wooden stake. This laid him up and brought on fever, and he had to be carried in a hammock for the next two weeks. Abercorn Station I found much improved since I was there two years ago. A stockade has been built round the settlement, and the stream which enters Lake Tanganyika in Rhodes Bay had been diverted and a new channel dug for it. This has drained the flat below the station, which instead of being swampy as it formerly was, is now excellent planting land. A few hundred natives from surrounding districts have settled with the whites at Abercorn, and are building villages in Rhodes Bay. Abercorn has more trade than any of the other stations in British Central Africa, not only trade in ivory with the Arabs, but also in cloth and other trade goods, provisions, hardware, etc., with the various Europeans now on Tanganyika. The station has no boat or steamer; the possession of one would enable them to multiply their present trade many times over. Throughout the Tanganyika and Mweru districts the rainfall of 1892 (January, February, and March) was unusually heavy. The little lakelet of Kilo near the village of Zombe, which for some years past has been quite dry, is now full of water. In Ulungu and Itawa the rice crops were much damaged by the floods, and, as a result, food was very scarce. Mr. Swann, the London Missionary Society's agent on Tanganyika, having kindly offered to transport my caravan to Sumbu at the south-west corner of Tanganyika, I left Abercorn in the mission steamer *Good News* on September 7th, and reached Sumbu the same night. The steamer had to return to Abercorn to bring over the remainder of my

caravan. Bwana Teleka, the chief of the Arab town of Sumbu, was away on a journey with ivory to the coast. Mwine Kambi, his headman in charge of the town, was civil and obliging. From here I sent letters on to Abdallah bin Suleiman, telling him of my arrival in Itawa, and that I should shortly visit his town. The latitude of Sumbu I found to be 8° 29′ 20″.

The first day's journey on leaving Tanganyika going west is rather bad—stony hills and thickets. I only took a short march of 8 miles to the Kikuka waterholes. Three miles after leaving Sumbu I crossed the dry, rocky bed of the Mungela River which runs into Tanganyika some 3 miles north of Sumbu. (In Captain Hore's chart of the south-west end of Tanganyika there is a stream marked as Mongera, placed as running into the lake some way south of Sumbu. The name is the same (in native ears) as Mungela, and it is evidently the same stream; but Captain Hore has probably put it in by report, and has been mistaken.) My camp at the Kikuka waterholes was in south latitude 8° 31′ 2″. On September 12th I travelled 15 miles to Mkula's town, which I found to be in lat. 8° 30′ 38″ S., having during the day crossed the watershed between Tanganyika and Mwe. From Mkula's to Mweru the country is mostly level, and there would be little difficulty in making a good road. Mkula's town is situated on the Chisela River. This has been at some previous period a large river, but now it is a succession of reedy, grass-covered pools, and the stream does not run except during the rains. Leaving Mkula's on September 11th, I crossed the Chisela and followed its right bank to its entrance into the Mweru Swamp (old lake). I then followed the northern shore of the swamp to its north-westernmost corner, and cutting off a piece of it reached and crossed the Choma River. This great Mweru Swamp is the old lake, the southernmost corner of which I crossed in 1890. Its average width is from 14 to 16 miles, and its length about 35 miles. It lies north-east and south-west, and is now a vast sea of green reeds and swamp-grass, with occasional patches of open water. Many elephants find a safe refuge in it, and only come out while the heavy rains are on. My first camp west of Mkula's on the shore of the swamp was in lat. 8° 29′ 18″, my next in 8° 28′ 48″. On September 16th I crossed the Choma River, a deep muddy stream 10 yards wide and 2 feet deep (in the dry season), which runs into the Mweru Swamp at the north-west end. The Choma is the only permanent stream of running water crossed between Tanganyika and the north end of Lake Mweru (Moero). On leaving the Choma I found myself in the Mweru Salt Country. Salt is taken from here to Tanganyika, Lunda, Mambwe, Iemba, and even to the countries on Lake Nyasa. The country traversed between Mkula and Kaputa was without inhabitants—a poorly-watered country but full of game, mostly buffalo, zebra, roan antelope, pookoo (*Cobus varondi*), lechwe, etc. The

two last named antelopes go in large herds, and are often found together. They are very much alike in appearance, and are, together with the impala, known by the natives by the name of "Nswala." At Kaputa there are hot springs; but I doubt whether these have any connection with the salt deposits. The inhabitants of Kaputa get their water from the Choma River, 2 miles away. They grow little or no food crops, but buy from others with salt. From Kaputa I went south-west to Mkupa, another salt-making village, the track leading us over large plains, the soil of which is impregnated with salt.

Salt is obtained thus: The salt soil is dug out and carried into the villages; here everyone is a salt-maker. Large funnels made of twisted grass rope are placed on stands, the funnel is filled with salt soil, water is poured in, and the mass stirred up well; the water then filters through and drops from the bottom of the funnel into earthenware pots placed below. This salt water is then boiled and the water evaporated. A certain amount of dirt remains with the salt, but the African has no objection to that. The crystal is rather large. From Mkupa I went south-west and west, and camped on the Kasalawa rivulet, no running water but occasional pools. This camp was in lat. 8° 34′ 53″ S. From here I went in two days direct to Rhodesia, the administration station on Lake Mweru. The district between Mkupa and Mweru is undulating and covered with scanty forest. Water is rather scarce, but can generally be got in pools and holes here and there throughout the country. The soil is good and the rains plentiful during their season; but there are now no inhabitants owing to the former raiding work by the Arabs under Tippoo Tib's people, and latterly by Abdallah bin Suleiman. At Rhodesia I found Mr. Crawshay, who had been in charge of that post for nearly a year. Rhodesia Station is situated at the extreme north-east corner of Lake Mweru on a cliff some 80 feet above the lake shore. The climate of Mweru seems to be healthy: Mr. Crawshay enjoyed good health during the time he was there. Rhodesia is on the direct road to the west, and is the nearest point of Mweru to Tanganyika. Round Rhodesia and Mputa there are salt deposits similar to those of Kaputa. The inhabitants of Mputa (a village close to Rhodesia) used to work the salt; they have, however, recently been driven out by Abdallah bin Suleiman. The latitude of Rhodesia is 8° 39′ 28″.

Having put together the steel boat, and left the caravan at Rhodesia, I left on September 22nd for Abdallah bin Suleiman's. I travelled south-east to where the Movu river-bed issues from the great Mweru Swamp. I found this river as I had found it in 1890, a marshy bed, but with no running water in it. Mr. Crawshay, however, informed me that during the past rainy season it was full of water, and that he had crossed it waist-deep. Vast herds of game covered the plains at the south end of the Mweru Swamp. I crossed the Mkubwe River

on the 23rd, and reached the ruins of Nsama's large town in S. lat. 8° 59′ 35″. The Mkubwe River, which runs into the Mweru Swamp from the south, is a similar river to the Choma, but larger, muddy, deep, and full of crocodiles. Nsama, the Chief of Itawa, who had his town fourteen miles west-south-west of Abdallah's town, gave me much assistance two years ago on my journey to Katanga, and supplied me with a few carriers. In 1891, however, he was attacked by Abdallah bin Suleiman. The siege of his town lasted for three months, and eventually, with the assistance of some of the Awemba tribes, Abdallah drove him out. Nsama was killed and his people scattered, many were captured and sold as slaves. Nsama had two sons, Chipimbiri, who had a small town near the Mweru Swamp, and Mkula, who still holds a strong mud-walled town. Mkula is looked upon as the successor of Nsama.

I reached Abdallah's on September 25th. His headmen met me some distance from his town and escorted me in. He treated me hospitably. I left Abdallah's on September 27th, and reached Rhodesia again on October 2nd. On the way I caught a young elephant, but it was too young to rear; it died after two days. I endeavoured to rear it on tinned milk, but it did not take to it; it had got knocked about too much in the catching.

I decided that Mr. Kydd should march by land with the caravan to Kazembe's, and that I would explore in the boat the northern, western, and southern shores of Lake Mweru, and meet him at Kazembe's town. I was anxious to ascertain the course of the Luapula River from its entrance into Mweru up to the highest point of navigation. I left there in a boat with six natives on October 4th. One day took me the length of the northern coast of the lake to the north-western corner, latitude 8° 31′ 28″. Mpueto's is a mile-and-a-half north from the lake shore.

On October 5th I passed the exit of the Luapula River (which I visited in 1890)* and sailed down the west coast of Mweru to Chipungu's town. Thence, in three more days, to the southernmost corner of the lake. The northern half of Mweru's west shore is bounded by cliffs rising abruptly from the lake shore to 150 to 200 feet. Below these cliffs there is absolutely no level ground, nothing but a mass of broken rocks which have fallen from above. It is only here and there where small streams from the hills behind have broken gorges through the cliffs, and carried out deltas of rich loamy soil, that a landing can be safely effected or habitations met with. On each of these little deltas is a small village or collection of huts. The people were at first very timid, but when recognised (having travelled by land up this coast of Mweru two years ago) I was everywhere well received and supplied with quantities of food. In S. lat. 9° 5′ 10″ the cliffs cease, and thence,

* See *Proceedings*, R.G.S. January, 1892.

going south, the lake is bordered by flat land and marshes. The southernmost portion of the lake (in lat. 9° 30′) is the south-west corner which ends in a large, shallow, weed-covered bay. All the southern end is very shallow, the depth 3 miles out from the shore being only from 8 to 12 feet. This end of Mweru is gradually filling, the Luapula is silting it up. Lions are very plentiful along the southern shore. I shot two and saw several more. One night my camp was fairly besieged by lions. Passing along the old southern shore, past the entrance of the Luapula River, I entered the inlet at the south-east corner, which on my visit to Kazembe's in 1890, I was told was Mofwe. I thought that by following this up in the boat I should reach near to Kazembe's, and I had on my previous visit been told that Mofwe communicated above with the Luapula River.

On my first journey to Mweru and Kazembe in 1890, I had no sextant with me; on my present trip I found that all my estimated latitudes on the previous journey were much too far north. I now found that Mofwe did not communicate with the Luapula River. The inlet at the south-east corner of Mweru—which is called Chimbofuma—is merely a deep bay into the vast swamps which lie at the south end of the lake. It is separated at its south-east end from the Mofwe lagoon by 2 or 3 miles of dense swamp, impassable either by boat or on foot. After coasting round the Chimbofuma inlet, therefore, and ascertaining that there was no exit from it to the south, I sailed back into Mweru, and returned along the south shore to the entrance of the Luapula River. It enters Mweru by several branches, or rather it has formed many reedy islands at its mouth. It is easy to see at the mouth of the river how the swamps lying at the south end of the lake have been formed. Floating plants are carried down and collect together; reeds take root on them, an island is formed, and the deposit brought down by the river joins island to island. The depth at the entrance is 7 or 8 feet (dry season); once inside the river the depth increases to 3 fathoms, and from the lake right up to the falls of the Luapula in S. lat 10° 30′ 46″ there is never a less depth than 10 feet. It is a magnificent river, from 250 yards to a ¼ mile in width, slow running with clear water, no rocks or sand banks. From Mweru up to the falls the rate of current is from 1 mile to ½ mile per hour. It is a very similar river to the Upper Zambesi just above Zumbo, except that the current is much slower than that of the Zambesi. The latitude of the mouth of the Luapula at its entrance into Mweru is 9° 25′ 30″.

Shortly before my arrival at the north end of Nyasa, that district had been visited by the cattle plague, which has been raging through East Central Africa during the past year. Practically, all the cattle of the north Nyasa country are cleared out, the mortality being over 90 per cent. On my way across to Tanganyika I found that parts of the country had been visited and portions had escaped. I had

heard that this disease had also attacked the wild game; I had no actual evidence of it, however, until I arrived at the south end of Lake Mweru. Here enormous quantities of game have died: for the first two days up the Luapula, where it passes through marshes, it is near the banks only of the river where good dry land is found. These banks are, or were, covered with game, mostly pookoo, buffalo, and lechwe. At the time of my passing up through these swamps the plague was at its height. Dead and dying beasts were all around. The first day I counted over forty dead pookoo within ½ mile of my camp. Subsequently, on my return down the river, I saw scarcely any live game near the mouth, but the whole country was scattered with dead bodies. The natives from about Kazembe's were going with canoes, backwards and forwards, carrying the dead meat up to the villages beyond the marshes. Elephants, of which there are great numbers in these marshes, do not appear to have been attacked by the plague.

Mweru is a lake of gentle winds. There seems to be no prevailing winds as on Lakes Nyasa and Tanganyika. I found the winds mostly from the northern half of the compass, and these enabled me to use my sail for the first two days up the Luapula River. In S. lat. 9° 48′ I reached a narrow creek which entered the Luapula on its east bank, and which I was told by the natives led up to Kazembe's town. By poling and pushing I got the boat up it. This creek, leaving the firm land near Kazembe's, enters the marshes, and passing through them to the Luapula, forms a means of communication by canoe with the river. Following this creek up, I got my boat up to the dry land (the old shore of Mweru Lake) and thence went by land to Kazembe's town, which I reached on October 15th, and found that Mr. Kydd and the caravan had already arrived. Kazembe sent out the British flag to meet me, with a deputation conveying hospitable messages and greetings. On October 16th I was received by him with much state and ceremony. The recent death of Mshidi, the Chief of Katanga, had evidently made Kazembe somewhat afraid of Europeans, but knowing me of old, he soon became reassured. Lunda, Kazembe's country, is a rich agricultural country, very different to Itawa. Lunda is well watered by permanent streams of running water, and the vegetation is much more luxuriant than in the countries north of it. The tsetse fly, however, is very plentiful throughout both Lunda and Itawa. East of Lunda lies the Awemba country, into which it is difficult to enter at present, owing to the desire on the part of the inhabitants and of the Arabs to keep us out as long as possible. The Awemba country is a great feeder of the slave trade. Caravans can always obtain slaves there.

On October 17th I left Kazembe's, and sending the caravan on overland to meet me on the Upper Luapula, I rejoined the river in the boat, and followed it to the south. The latitude of Kazembe's present town is 9° 48″, some 8 miles south of the Mbereze River. The swamps lying to the west of the town, and which on my first journey I took to be part

of Mofwe, are in reality south of the Mofwe lagoon. This lagoon, however, is gradually filling up, and will before long form part of the marshes. On the shore of the Mofwe lagoon are visible the banks and ditches which surrounded a town where a previous Kazembe had resided. The Kazembe of to-day is not such a great chief as the Kazembe of one hundred years ago, when Dr. Lacerda's expedition visited this country; and I cannot help thinking that the accounts given by Pinto (the historian of that expedition) are much overdrawn. Still, there is far more ceremony and State at Kazembe's than at any other part of Central Africa I have been in. Ascending the Luapula I reached the limit of the swamps in lat. 9° 55′, and from here upwards for some miles were dry plains. There is, however, one point in the marshes of the Luapula where the high ground on the west approaches the river, a tongue of land; it reaches the river in about lat. 9° 44′, and here is a village of Mshidi's people cut off by the Luapula and the intervening swamps from Kazembe's people. In lat. 10° 4′ 1″, the first of Kazembe's villages on the Luapula was passed on the east bank. From here upwards the country on that bank is undulating and wooded with gentle hills, and villages of Kazembe's people are met with here and there up to the Falls. On the west bank the population is much smaller, but now numbers of Mshidi's people are giving in their allegiance to Kazembe, and are building villages on the west bank. In lat. 10° 12′ a large river joins the Luapula on the east bank. I conclude that this must be the river marked on existing maps as the Luongo. The natives, however, call it the "Ruki," and do not know the name Luongo. Above the Ruki plains the Luapula is very beautiful, passing through gently rising, wooded hills; the water is always deep and clear. The inhabitants of the villages on either bank are simple, friendly people, timid at first, but eager to barter produce as soon as they found we had no wish to hurt them. In lat. 10° 22′ 16″ there are some remarkable red cliffs on the west bank.

On October 22nd, soon after starting, I heard the sound of rapids, and presently reached the head of navigation of the Luapula in lat. 10° 30′ 46″. The river here rushes through great masses of rock. In places the water has worn channels for itself below and between the rocks, and portions of the river are for some way bridged by them. The water was extremely clear (dry season). Here and there were pretty little bays with bright, sandy beaches. I found that a fine, clean-looking fish of from one pound to five pounds took eagerly both a spinning bait and a fly, and I had some really excellent fishing, making flies with red and white calico, and using a long, springy bamboo as a rod. As I had, however, no reel, and no landing net, I lost many fish. I christened the falls, in the absence of any special native name for them, "Johnston Falls." I put the caravan in camp here for a week, and took three short journeys; one for 10 miles up the river, which I found to be nothing but a succession of cataracts

one to the east for 12 miles; and one to the west for 8 miles. The country to the east I found dry and thinly forested, gentle rises and descents. Four days east of Johnston Falls, I was told, were the "Mchinga" (high range of mountains) and one to two days beyond that was Bangweolo Lake. The name Bangweolo is not known, however, the lake being spoken of as the "Mweru of the Awiza." The Awiza people are said to live on islands in the lake. Mshidi's old town was said to be six days' journey west from Johnston Falls, This point, therefore, forms a very central position, as in addition to being so near to the Bangweolo and Katanga Districts, water carriage to Rhodesia puts it within seven days' *land* journey of Tanganyika. At the Falls I bought seven large canoes, in which, and in the boat, I stowed all the loads of the expedition, and in this manner I transported everything by water all the way back to Rhodesia Station. This enabled the carriers to travel without loads, and therefore with speed. On October 29th, small-pox broke out in my camp—two cases, a Zanzibari and an Atonga native. I left them in one of Kazembe's villages in charge of the chief, with plenty of cloth to provide for their wants, and to bring them home when recovered. I had originally hoped to return to Karonga by way of Lake Bangweolo, and by the Chambezi River through the Awemba country, but finding that the time at my disposal would not allow of it I decided to return by way of Tanganyika. I left Johnston Falls, therefore, on October 29th with the steel boat and seven canoes, the caravan going overland.

The rains commence much earlier on Mweru and the Luapula than in Nyasaland. Heavy rains began with us on October 23rd, and until the middle of November we had constant rain. There were some terrific thunderstorms on my way down the Luapula. Passing through the marshes I saw numbers of elephants, and shot seven. It is a very difficult country to shoot in, however, as the elephants when disturbed or wounded go straight into the marshes where it is impossible to follow them. One sinks in mud and water sometimes to the neck, leeches are plentiful, mosquitos thick, the razor-like grass cuts one's hands, and minute spears on the grass stalks pierce any part of the skin they touch.

I re-entered Lake Mweru again from the Luapula on November 6th, and coasting along its southern shore to the Chimbofuma inlet, followed up the east coast to Rhodesia Station, which I reached on the 9th, thus completing the circumnavigation of the lake. The Kalongwizi River which enters Mweru from the east, has thrown out an extensive delta into the lake. This consists mostly of papyrus swamp, but the beach is sandy. Very little water comes down the Kalongwizi in the dry season. On the bar there was 18 inches of water: inside, 1 fathom.

From the time of leaving Kazembe's village to arriving at Rhodesia no food was procurable, and on from Rhodesia until I reached Mkula's not a grain of food could be bought. The caravan was thus for three

weeks without any food except the meat we shot. Fortunately, of game there are unlimited quantities throughout those districts, and the men were never long hungry. Any caravan passing through this piece of famine country, whose leaders were not keen about shooting, would starve. Having joined the caravan at Rhodesia, I travelled east to Mkula's, leaving the station on November 11th and reaching Mkula's on the 16th.

From Mkula I travelled to the head of Kamba Bay (Tanganyika), leaving Sumbu to the north. The road from Kamba to Mkula is better than that from Sumbu, and there is more water on the way. From Kamba I went on to Abercorn Station, calling at Kabunda's, the Baluchi. I also called at Niamkolo, the Tanganyika Station of the London Missionary Society. Mr. Swann, the missionary in charge there, had recently been with the mission steamer *Good News* to Ujiji. He saw Rumaliza there (Tippoo Tib's partner), with whom he has been on friendly terms for some years past, and was told by him that the Arabs are much exercised in mind by the war troubles east and west of Tanganyika, and that it was possible that they might all join in a war against the Congo Free State and the Germans. Ujiji was being fortified by Rumaliza, who had taken down the German flag he had for some time flown.

On November 25th I left Abercorn and travelled to Fwambo, where I was delayed two days, and thence hurried on as fast as possible towards Nyasa, in the hope of catching a steamer at Karonga, and I sent messengers on ahead to delay the steamer should she reach there before my arrival.

I arrived at Karonga on December 8th, found the steamer there, paid off my carriers, and left on the 9th for the south. I reached Fort Johnston on December 16th.

All the natives I took on my journey, except two left behind to recover from small-pox, returned in good health. I had no losses by death. Throughout the journey I never had occasion to fire a shot nor to use any force, and was everywhere well received and well treated.

I took no observations for *longitude* on this journey.

MR. ASTOR CHANLER'S EXPEDITION TO EAST AFRICA.*

The following letter dated Hameye, on the River Tana, March 8th, 1893, has been received from Mr. William Astor Chanler, the leader of the expedition towards Mount Kenia in East Africa:—

I enclose you a map made by Lieut. von Höhnel, of a journey I have just made. The map speaks for itself. It is made with scrupulous accuracy and is the result of many hours' hard labour. The positions are all

* Map, p. 576.

based on the position of Hameye, which has been fixed by a series of star occultations.

A few words, however, may not be amiss. The Mackenzie River is about 12 yards wide and nowhere more than 3 feet deep. It flows for the first 15 miles through alluvial soil mixed with occasional lava blocks; thence through gneiss. The head-waters of the Mackenzie swarmed with game of all sorts. The country lying to the north of the Jombéné Range and bounded by the Guaso Nyiro is strewn with lava blocks. The Guaso Nyiro flows in a gneiss bed, except in the neighbourhood of "Chanler Falls," where a mass of lava has forced itself into the course of the river. It is over this mass that the river pours in two streams. The fall is something over 50 feet high. Below the falls for 2 miles the river flows between sheer walls of black lava. The Guaso Nyiro is here 80 yards wide and varies from 5 to 8 feet in depth. In the neighbourhood of the "Marisi el Lugwa Zambo" Plateau, the river ceases to flow through gneiss, and flows from thence on through alluvial soil. The "Marisi el Lugwa Zambo" Plateau is purely volcanic. It rises abruptly from the plain 500 feet. The Guaso Nyiro, in its passage through the plain, dwindles away till at the last point we saw it it was barely 10 yards wide and only from 1 to 2 feet deep. The Lorian Swamp seemed of great extent and was filled with high reeds. The country to the north of Lorian seemed undulating desert covered with scrub. We saw not one native from Hameye to Lorian except on the Jombéné Range. This whole tract is uninhabited. We saw in the neighbourhood of the Marisi plateau zeribas which had held people having camels and goats —probably Randhilé, who visit this country during the rainy season. The Randhilé two years ago visited and established trading relations with the natives of the Jombéné range. They had many camels, my informant said. We saw many zeribas of Wandorobbo. We got a capital view of Mount Kenia from the western portion of the Jombéné Range. The mountain looked waterless on this, the north-east side. It was covered with many craters. The forest belt passed very high, say 10,000 to 11,000 feet. On the eastern portion the forest extended to the plain. The lower slopes were grassy. The Jombéné Range is very fertile and is thickly inhabited. The Wa-msara inhabit the western slopes. They are warlike, and do not pay so much attention to cultivation as the Wa-embe, who inhabit the eastern portion of the range. Both these people are offshoots of the Kikuyu race. They speak a dialect of the Kikuyu language, but use many Masai and Mkambu words. Many Wakamba and Wakwari are settled among them. The Wa-embe are industrious cultivators; they grow sweet potatoes, yams, cassava, beans, sugar-cane, and millet of two sorts. They are fast destroying the forest with which this range was evidently formerly covered. We start to-morrow for the north *viâ* Mount Kenia and the eastern slopes of the General Mathews Range.

NOMENCLATURE OF THE OCEANS.

It is interesting in connection with the nomenclature of the greater divisions of the hydrosphere to remember that a Committee was appointed by the Royal Geographical Society in 1845 to deal with the whole matter. This Committee met once, and was adjourned on January 27th, 1845, but there is no record of a subsequent meeting. The sub-divisions of the oceans now generally adopted date from this meeting, and as very full minutes of the discussion have been preserved, but were never published, it is desirable to place them on record.

1845. *Copy.*

January 27th.

The Committee appointed by direction of the Council of January 13th to take into consideration the divisions of the ocean and the respective limits of these divisions met this day at two o'clock, there being present, Mr. Murchison, President, in the chair, Sir G. Back, Captain Beaufort, Sir John Franklin, Mr. Greenough, and Captain Smyth; Mr. Arrowsmith being also present.

The President having opened the business of the meeting, Mr. Greenough observed that the present divisions of the ocean and the names they received were very arbitrary, and that a systematic arrangement was desirable. He despaired of changing the common parlance in these matters, but was of opinion that geography, like other sciences, should have its philosophical system, and that, as in the cases of the Linnæan and Jussieuan systems of botany, etc., so a geographical system, if found to be a good one, would be received by the scientific world, particularly if accepted and encouraged by those departments, such as the Admiralty, &c., whose sanction would go so far in such matters, and that what in the beginning would be confined to the scientific would become familiar to the many to great advantage of the science itself and of general knowledge. With regard to the particular object of the meeting, and in conformity with his conviction that a partial change in the present divisions of the ocean would be attended with no good results, he had prepared, in order to submit to the consideration of the meeting, a totally new division of the ocean into zones.

The President was of opinion that no great changes of the kind contended for by Mr. Greenough, however good they might be, were likely to be received unless brought forward prominently at a meeting of the British Association.

Mr. Greenough instanced Linnæus, Cuvier, &c., as individuals whose systems had been universally adopted.

Captain Beaufort thought that, though the precise limits of the several oceans were not accurately defined, they were sufficiently so for all practical purposes. He saw no objection, however, to defining them more precisely; but was decidedly opposed to new names, such as those proposed by Mr. Greenough. He thought the change uncalled for, and, even if admitted by ourselves, was not likely to be adopted by other nations.

Captain Smyth regretted the very vague signification of the term "South Sea," and was of opinion that without any appearance of innovation the following divisions might be settled, viz.—The Arctic Ocean and the Antarctic Ocean; the North Atlantic and South Atlantic; the North Pacific and South Pacific; the North Indian and South Indian Oceans. He nevertheless concurred with Mr. Greenough in the desirableness of a systematic arrangement of the Ocean founded upon philosophical

principles, and saw no reason why there should not exist at the same time a philosophical and a popular arrangement of the facts of physical geography.

Sir George Back thought it advisable to retain the existing names of the oceans, but opined for a determination of their respective limits. In this opinion Sir John Franklin concurred.

The Secretary read some notes he had made, showing that both the divisions of the oceans and their respective limits were differently determined by different authorities abroad and by ourselves.

Sir John Franklin, Mr. Arrowsmith, and other gentlemen present then explained their several views as to the limits of the several oceans as popularly known. Finally the general opinion entertained was that the present names of Arctic, Antarctic, Atlantic, Indian, and Pacific Oceans be retained; that the limits of the Arctic and Antarctic Oceans be respectively the Arctic and Antarctic Circles; that the limits of the Atlantic on the north and south be the Arctic and Antarctic Circles. That its western limit be the coast of America as far south as Cape Horn, and thence prolonged on the meridian of that cape till it meets the Antarctic Circle; that its eastern limit be the shores of Europe and Africa as far south as the Cape of Good Hope, and thence prolonged on the meridian of Cape L'Agulhas, till that meridian cuts the Antarctic Circle; that the Indian Ocean do extend from India and Persia on the north to the Antarctic Circle on the south; that its western limit be the shores of Arabia and Africa as far south as Cape L'Agulhas, and thence along the meridian of that Cape to its intersection with the Antarctic Circle; that its eastern limit be the west coast of the Birman empire and a part of the Malayan Peninsula, the west coast of Sumatra, Java, Timor, and Australia, as far as the southernmost point of Van Dieman's Land, and thence continued along the meridian of that point to its intersection with the Antarctic Circle; that the Pacific do extend from the Arctic Circle on the north to the Antarctic Circle on the south; that its western limit be the east coasts of Asia and of the island of Sumatra, the northern shore of Java, Flores, and Timor, and the coasts of Australia from Melville Island round to the southern point of Van Dieman's Land, and along its meridian to the Antarctic Circle, and that its eastern limit be the west coasts of America and the meridian of Cape Horn as far as the Antarctic Circle. It was further agreed that the Atlantic and Pacific Oceans be sub-divided into three portions: a northern and southern and an intertropical, and that the Indian Ocean have but two divisions—an intertropical and southern.

This arrangement being agreed upon, Mr. Greenough and Captain Smyth were requested to concert together on the subject of a scientific system of classification of the oceans, seas, gulfs, bays, &c., to be subsequently submitted at their convenience to the consideration of the Society. (Signed) Rod. I. Murchison.

THE PHYSICAL AND INDUSTRIAL GEOGRAPHY OF CALIFORNIA.*

By Professor E. W. HILGARD of San Francisco.

The great change which has taken place in the physical conditions of California since the days of Bret Harte and Mark Twain is apparent from the fact, that for some time the only method of goldmining possible in certain districts, *viz.*, the

* Report of paper read at the Berlin Geographical Society, February 4th, 1893.

hydraulic, has been prohibited by law on account of the injury caused thereby to the agricultural interests. The State of California has a coastline of about 700 miles, an average breadth of 200 miles and a superficial area of about 156,000 square miles. This great area is peopled by only 1,300,000 souls, of whom 250,000 inhabit the city of San Francisco. The tempering influence of the sea causes a much greater equability of climate as between the north and south than might be expected having regard to the length of the country; on the other hand the climate changes very rapidly as one proceeds from east to west. In the east the gently rising Sierra Nevada forms a natural boundary. It is well wooded, from about 3600 feet, principally with conifers; the foothills are sparsely clothed with pines, oaks, and underwood. The coast range is a mountainous region with an average breadth of about 62 miles, which, in contrast with the very simple chain of the Sierra Nevada, consists for the most part of two or three broken parallel chains, seldom rising over 3300 feet in height, between which run numerous river valleys to the north-west, some of them broad and very fertile. The rounded ridges of the coast chains are as a rule only sparsely wooded, but the forest region between the outer and inner coast ranges in the northern half of the country, which is the home of the valuable red-wood (*Sequoia sempervirens*), is an exception. The coast is rocky; the wind, blowing almost always from the sea, renders navigation dangerous, and there are only a few good harbours. Between the Sierra Nevada and the mountains of the coast lies the great central valley, which is about 400 miles long and 62 miles broad. This central valley is a well-cultivated district, comprising nearly one-ninth of the entire State, and is almost throughout, where watered, of remarkable fertility. Flowing through it from the north is the Sacramento River and from the south the San Joaquin; the two rivers, after uniting about halfway down the valley, turn westwards, and then after forming three lake-like extensions (the bays of Suisum, San Pablo, and San Francisco) finally pour their waters through the Golden Gate into the sea. All the more important affluents of this river system flow down in deep cañons from the Sierra Nevada. The great valley was originally a fresh-water lake, which, before the gap of the Golden Gate existed, discharged its waters southwards by means of the Pajaro River into the Bay of Monterey. The remains of this lake are seen to-day in the Tulare Lake, but this lake is quickly drying up, as the utilisation of the streams for irrigation leaves an ever-diminishing quantity of water in its basin. The great valley is shut off on the south by a mountain mass, the Tehachipi Range, formed by the conjunction of the Sierra Nevada and the coast range, on the other side of which lies the Mojave tableland at a height of about 2000 feet, and on the further side of that, the region of South California proper, the chief centre of the orange cultivation. The western part of the Mojave plateau presents wide expanses of country, capable of being cultivated, if artificially irrigated.

The prevailing wind, except during the winter months, is the south-west wind, which blows off the sea cooled by the Alaska current, and lessens the heat very considerably. In the central valley these south-west winds enter through the Golden Gate and blow in the northern part as south winds, and in the southern part as north winds. North of San Francisco, Cape Mendocino forms a climatic dividing-line, for on the other side of it the north-west winds prevail, and the rainfall increases considerably. In the winter the winds are very variable; the rain storms spread with a south wind from Paget Sound to the south. The north winds correspond with the sirocco of the Mediterranean; they occur always when the sky is clear and the atmosphere very dry, and are so hot at times in the summer that the crops are burned up. These winds last from one to three days and are most frequent in June and September; in some years they are never experienced

The climate of the coast is very cool and equable; the difference between the mean temperatures of the summer and winter in San Francisco is only 3°·6 (Fahr.). Thick mists are frequent, but it is only in winter that they extend into the interior and to the foothills of the Nevada; in summer they melt away on the slopes of the coast range. In the great central valley the temperature rises sometimes as high as 100° (Fahr.) and in the summer it stands daily at from 86° to 95°, but owing to the great dryness of the air this heat is not burdensome, and sunstroke is unknown. In winter the lowest night temperature falls often below freezing-point and even as low as 28°·4 (Fahr.); at times a little snow falls, but melts quickly. In San Francisco snow is very rarely seen. The climate just described extends up to an altitude of from 2000 to 2300 feet to the foothills of the Nevada and similarly to the coast mountains. In South California the heat as well as the cold is less, and even on the coast the mists are less frequent, because the Alaska current at Cape Conception trends away somewhat from the coast.' Semi-tropical fruits can consequently be grown there with greater success.'

In California, south of Cape Mendocino and north of the Tehachipi Mountains, almost the whole rainfall of the year occurs in the six months from November to May. A five months' drought is nothing to be alarmed at in California. "A green winter and a brown summer" is the normal state of affairs. The cereals are sown from November to April, and according to circumstances the crop is turned into hay or corn, for there are no meadow lands except those created by artificial irrigation. To the south of the great valley the rainfall is very small; at Bakersfield from 4 to 6 inches only, but it increases on the east side of the valley fairly regularly up to 19½ inches at Sacramento, and at the north end to nearly 27½ inches. The rainfall decreases westwards and is about 4 inches less than that of the eastern side of the valley. In the coast range the rainfall varies according to the formation and direction of the openings of the valleys, so that there are numerous "local" climates, which present special facilities for particular kinds of cultivation. In North California the rainfall reaches as much as 78½ inches, and in the Sierra Nevada the increase of rainfall with the altitude proceeds at the rate of about 1 inch per 100 feet. In spite of that the character of the foothills up to 2350 feet is almost like that of the great valley. Higher up, say up to 4600 feet, fruit is extensively grown; grapes, peaches, pears, and apples. Higher up still the timber and mining industries, together with sheep-breeding, are carried on. The cultivation of fruit and of the vine flourishes in the valleys of the coast range, which in some parts are thickly populated; in many places asphalt, petroleum, quicksilver, and peat of the best quality, are obtained. In addition dairy-farming is extensively pursued, and good breeds of cows and horses are reared. Further south, beyond the watering-place of Santa Barbara, large quantities of maize and beans are cultivated, and swine-breeding is a flourishing industry. The effect of artificial irrigation on the arid soil of the central valley is simply marvellous. For instance, the Plain of Fresno, which fifteen years ago was as bare as a threshing floor, is now one huge vineyard and fruit garden, intersected by thousands of irrigating channels, and full of fine country houses. Whereas in the Mississippi States about 50 acres of country are reckoned necessary for the support of one family, in California 12½ are sufficient. Wheat is now only cultivated where irrigation is not necessary. On account of the extreme climatic conditions of the east of the United States vine cultivation is only practicable in California; the cultivation of raisins and the production of sweet wines make every year enormous advances. Dry wines grow specially well in the valleys of the northern coast range, in Sonoma, Napa, Sta. Clara. California possesses a further

monopoly in French plums, so much so that this fruit has almost entirely ceased to be imported from France; also in apricots and figs, the latter being produced in the Eastern States as green fruit only, whereas in California the Smyrna figs do well as dried fruit. In the State there are about six million orange and lemon-trees, and thousands of acres are covered with olive-trees. The cultivation of the sweet turnip has also made great strides. In suitable places date-trees grow splendidly; and through the introduction of ostrich-breeding the home demands for feathers have already been met. In North California hops and barley flourish in a remarkable manner, and beer brewing has consequently been much developed in the cooler regions of the Sierra. Generally, there is probably no market in the world where such a choice of home-grown products of various climates is to be found.

THE INFLUENCE OF THE NEW WORLD UPON THE OLD.*

By Professor Dr. J. REIN.

COLUMBUS, having brought to a partially successful issue, in spite of the most severe discouragement, the earlier scheme of Toscanelli to reach the east by sailing west, rendered to Europe an immortal service. The discovery of the sea-route to India, and the first circumnavigation of the Earth soon followed the discovery of America. In the intellectual life of Europe came, at the same time, the Reformation. Civilisation thus received new impulses; it was launched in a new direction, and brought to develop quite new forces. The material conditions also underwent a notable change, as wants grew with the means of satisfying them. North America soon became the great field of human energy, and here began a struggle for life unlike any which had ever before taken place; not the struggle between nations led by their chiefs, but the struggle of the bold and enterprising exiles from all parts of Europe, who overcame the difficulties of their surroundings, and learned to live without any other human protection than their own. Orderly states ultimately grew out of chaotic beginnings, during which the right of the strongest often prevailed. Virgin forests, prairies, and unproductive steppes were transformed into rich fields, and machinery for furthering labour was planned and made. The stimulus to inventiveness produced a crop of "Yankee notions." It was on the waters of the majestic Hudson River that the first steamer plied commercially; and on its shores the first Morse telegraph was brought into action.

The influence of the New World upon the material conditions of life in the Old World has been very varied. For most inhabitants of Europe, and even for the Maoris in far-off New Zealand, potatoes have become an every day food; Indian corn is even more widely spread; and tobacco has conquered the whole world. Many other useful plants have introduced considerable changes in our manners of life. Cacao, vanilla, logwood, mahogany, and other useful or decorative timbers, as well as the many ornamental plants of our houses and gardens, are among them. Among animal products there are guano and the wool of the alpaca and the vicuna from South America, cochineal from Mexico and Guatemala, the furs and the fishes of North America. American cotton affords a living and clothing for many nations of the Old World; American wheat, American wool, and American meat are competing with the farm products of all Europe; but they save us from

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* Abstract of the opening address delivered before the tenth Congress of the German Geographers at Stuttgart, 1893.

high prices and scarcity. However, the effects of the mineral treasures of America upon our life have been even more rapid, deeper, and therefore more evident. American gold, silver, copper, and lead, petroleum and Chili saltpetre have greatly affected the markets and exchanges of Europe.

These influences of America have acted chiefly during the last half of this century. They are so well known that it is sufficient to simply name them. But there are other consequences of the discovery and conquest of America which, although less evident, are perhaps of greater importance. To appreciate them we must return in thought to the day when Columbus came back from his first and chief journey. He landed in Palos on March 15th, 1493, from the smallest of his three ships, exactly thirty-two weeks after having left the same place.

The news of his return and discoveries rapidly spread. His journey to Barcelona was a triumphal march. Soon arose the rivalry of the Portuguese and their fear of being hampered in their enterprise in Africa. In consequence, Pope Alexander VI., himself a Spaniard, promulgated his famous bull dividing the Eastern World—over which the Portuguese held all rights of discovery—from the Western, which was similarly held as the exclusive property of Spain. The successive shiftings of the line of demarcation, which at that time could not be accurately determined, led to results of world-wide importance. Brazil thus became a Portuguese colony; the first circumnavigation of Fernão de Magelhães took place, and the treaty of Zaragoza (1529) was concluded, by which treaty Portugal paid the foolish sum of 350,000 ducats to Spain for maintaining its rights upon the Molucca Islands.

With the discovery of America and the sea-route to India began the glorious period for Spain and Portugal, but their material and moral decay began also. The eager thirst for glory and religious fanaticism made Spain the owner of half the New World, and brought to her incredible treasures of gold, silver, precious stones, pearls, and other forms of wealth. The discovery and the conquest of the new lands having been made at the expense of the Crowns of Castile and Leon, the industries of this part of Spain were favoured to the detriment of those of the lands of the Crown of Aragon. When the woollen-cloth manufacturers of Toledo, Valladolid, Segovia and Cuenca, could not supply the growing demands of the new settlers in America, it was not Valencia or Barcelona who came to their aid, but Genoa and the Netherlands. The same happened with other industries. Instead of leaving them to develop free under the increasing demand and the rise in prices, all sorts of obstacles were put in their way, and Louis annihilated them. When complaints rose about the high prices of various articles of export, Philip II. prohibited the export of leather goods, and established a maximum price for woollens, thus compelling the manufacturers to limit their productions to inferior goods. But this was not the only means of favouring foreign competition; nor were the means limited to the earthly part of man's life. By the end of this period Spain was depopulated, turned into a desert, brought to misery, devoid of any one of the elements which might enable a nation to rise morally and materially. Then came the Inquisition with its manifold terrible consequences.

In those times, when distinction was not made between piracy and war, the bold Dutch and English privateers who had plundered most of the Spanish-American cities, were received at home with the greatest respect. An instance of this kind is the history of Sir Francis Drake, the first English circumnavigator, and of his uncle, Sir John Hawkins, to whom the importation of potatoes to Europe is ascribed. With them, and with Sir Walter Raleigh, the first lasting influence of the New World on the British Isles begins. True that the two Cabots (Giovanni and Sebastiano Gabotto), in the service of Henry VII., had discovered Newfoundland

and the American continent in 1497; but little account was taken of the discovery, and it only stands in the diary of the miser King, who mentions under August 10th, 1497, the small importance attached to the discovery: "To him who found the New Isle, 10 l." Only the Portuguese Cortereals who reached Newfoundland three years later attracted the attention of their compatriots to the rich fisheries of the Ilhas de Baccalhaos, which Lord Bacon valued later on more than all the gold of Peru. The fishing was thus opened by Portuguese from Aveiro, who were joined later on by Basques and Frenchmen, long before the appearance of the English in the same waters.

Although Newfoundland is considered as the oldest possession of England in the New World, and although Sir Walter Raleigh attempted a colony in Virginia, still the first lasting English settlements date from 1607 only. The first colonisation of the low West Indian Islands, neglected by the Spaniards as they had no gold, falls in the same period. With religious freedom, moral earnestness and work, the immigrants, both Catholic and Protestant, began to build up their new country.

And what a difference now! The United States separated from their mother-country forty years before the Spanish colonies. But their intellectual and commercial connection with the mother-country has been maintained and ever strengthened. Of the exterior trade of the Spanish Republics, which attains £136,000,000, only one-fiftieth part is with Spain; while the lion's share of the exterior trade of the United States—that is, £126,000,000—comes to the United Kingdom; and next to it comes Germany, with £36,600,000. This is in time of peace; but the state of affairs in times of war are equally worth notice. During the War of Secession in 1861–65, the cotton exports from the States sank to $\frac{1}{12}$ of what they were in 1860, and the price of the pound of cotton rose to eight times its previous value. Many of us must still remember the influence of this cotton-famine which provoked in the remotest colonies of Britain the awakening of the noblest features of national character—an unlimited readiness to sacrifices for mutual support. Another consequence of the same war was that it gave a formidable impulse to cotton culture in Egypt, India, and elsewhere, which resulted in wild speculation in land in India, ending in a commercial crisis when peace was re-established in the Union, and the prices of cotton rapidly went down.

In the intellectual progress of mankind, the United States stand in the first rank, and they have their large part in having promoted the knowledge of the Earth. The opening of Japan and the careful investigation of the coral reefs of the South Sea are due to expeditions from the States. The North Americans were the first to send Stanley to Africa, and they took a lively part in the explorations of the Polar regions, deep-sea explorations, the study of climate, and astronomical discovery.

And finally, comparing the Columbus Exhibition in Spain with the World's Fair in Chicago, it is interesting to observe how the one only looks to the past, while the other is given to the present and to the future, and will contribute to establish a new bond between all civilised nations.

THE EARTH'S SURFACE AND SOLAR ENERGY.

THE newer deductive methods introduced by the leading German and Austrian meteorologists continue to yield abundant and excellent fruit. Closely following his masterly analytical studies on the thermodynamics of the atmosphere—of which the sense has recently been presented to the strictly English student by Professor

Waldo—Dr. von Bezold has communicated to the Berlin Academy of Sciences the first of a series on radiation. Although this paper is professedly only preliminary and a setting of matters mathematical into order, several facts of great importance are noted; as, for example, that in comparing the action of radiation on land and sea we ought to compare equal volumes, not, as is usual, equal weights of earth and water, and that, if we do so, the usual explanation of the contrast between oceanic and continental climates, as due to the different heat capacities of these substances, breaks down. On the other hand, the influence of evaporation is shown to be enormously greater than is usually supposed, a most discouraging result in view of the want of convenient methods of measuring amounts of water evaporated.

The discussion concludes by dividing the subject under three heads: First, total radiation and reflection: second, gain and loss of energy in particular sections of the atmosphere and of the Earth's surface; third, convection or transference of heat by air and water. Of these the first and most difficult has already been worked at by many investigators, and Dr. von Bezold proposes to restrict himself to the second and third. Following this arrangement, the latter part of his paper deals with the distribution of heat energy in a column of earth of unit horizontal section, extending from the surface downwards to a point where changes of the atmospheric temperature cease to produce sensible effects. Concerning this we note as important to observers of underground temperature, the need for information as to thermal properties of the soils in which such observations are made.

Similar considerations have already produced results of general interest in the hands of Dr. W. Zenker, whose methods—different from and less rigorous than those of Von Bezold—are described in the *Meteorologische Zeitschrift* for October, 1892. Dr. Zenker calculates, for belts of latitude, what the mean air temperature *ought* to be under certain assumed conditions of radiation, and compares the results with mean temperatures observed. The differences which occur—some positive, some negative—are found to afford at least a rough measure of the transference of heat from one part of the Earth's surface to another, although the considerations suggested by Von Bezold show that several other important factors are involved. In *Petermanns Mitteilungen* (Bd. 39, No. 2), Dr. Zenker gives a map showing the results of an application of this method to the distribution of temperature over the sea, and finds himself justified in drawing therefrom the following conclusions. The air is warmer than the computed temperature only when it either lies over water which has been moved from lower to higher latitudes, or has come in contact with land in latitudes lower than 40°; and colder when it lies over water which has moved from higher to lower latitudes, come in contact with land in latitudes greater than 40°, or proceeds from one of the great continental areas of cold. Each of these conditions of abnormality is extremely significant. The effect of transference of water is well marked in the North Atlantic. The air warms and cools faster than the water, nevertheless the mean air temperature is in excess where air and water move together northwards, and in defect where both move southwards, except where, during winter, the north-westerly winds from the cold area over Canada reduce the temperature, and give rise to the Newfoundland fog-banks.

In applied meteorology these results give promise of much progress; and in particular we may notice the hint given with regard to the relation of climate to the distribution of plants and animals. Where the temperature of the air depends upon direct radiation, as it does to a very great extent at inland continental stations where the land is level and there is no very active horizontal circulation of the atmosphere, it may be assumed that such temperature is at least an approximate measure of the sun's power, representing a certain sum of heat and light rays. But if the air temperature is abnormally raised or lowered through

transference by wind or other disturbing cause, the balance of heat and light is obviously disturbed, and the temperature becomes a different measure of the solar energy, the former case being indeed analogous to that of the climate of a hot-house. Thus, for example, A. de Candolle found that certain plants required a markedly larger sum of "accumulated temperature" to ripen them in the north of Scotland and the Orkneys than in more inland continental regions, which it would now seem is due to the fact that part of the sum represented artificial heating through south-westerly winds and oceanic influences, a part to which there is no corresponding supply of light and other rays. Dr. Zenker's investigations may enable us to calculate such corrections for sums of accumulated temperature as will render this method suitable for general application to questions of phenology.

THE MONTHLY RECORD.

THE SOCIETY.

Legacy by the late Earl of Derby.—The late Earl of Derby has left to the Society a legacy of £1000, free of duty. The late Earl had been a Fellow of the Society for forty years.

'The Geographical Journal.'—The June number concludes the first volume of the *Journal*. It has been considered expedient, owing to its increased size, to have half-yearly instead of yearly volumes. The success of the *Journal*, so far as increased sale is concerned, has been very satisfactory.

Lieutenant Peary.—We have received a telegram from Lieutenant R. Peary, U.S.N., in which he expresses regret that his intended visit to Europe cannot take place. Mr. Peary had promised to give an account of his discoveries in Greenland during his recent expedition at one of the Society's meetings this session; and only the urgent need of his personal assistance in preparing for his new and greater journey has prevented him from fulfilling his word. The preparations for the new expedition have been retarded by the somewhat sudden death of Captain R. Pike, the Newfoundland whaler, who so successfully took Lieutenant Peary to his destination, and returned for him last summer in the *Kite*.

Dr. Nansen's Expedition.—Dr. Nansen's preparations are now practically completed, and he sails on June 20th from Christiania, to make his way by the Kara Sea to the New Siberian Islands, where he hopes to get his vessel, the *Fram*, wedged into the northward drifting pack, and so to be carried across the Polar Basin.

EUROPE.

Entrance to the Mersey.—The Report of the Acting Conservator on the state of navigation of the River Mersey for 1892, contains some notes on a detailed survey of Liverpool Bay made during the

year by the Marine Surveyor, which has brought out some significant points in relation to the variations in depth in different parts of the bay since 1890, the date of the last survey. These changes are not directly caused by the dredging operations carried on in the river, but represent more or less accurately the net result of the action of wind and tide during the period. On the whole, the 30 feet contour line outside the bar has advanced some 350 yards to the north-westward, and the 18 feet contour some 200 yards outwards, since the last survey. Some idea of the magnitude of the "harbour works" of the Port of Liverpool may be obtained from the statement of the report that in 1892 over 1,000,000 tons of sand were removed from the cutting across the bar alone. This amount is nevertheless insufficient fully to maintain the channel 1000 feet in width and 3000 feet long at the desired depth, and the Conservancy are about to bring into operation a dredge capable of loading a cargo of 3000 tons of sand, from depths of 20 to 45 feet, in three-quarters of an hour. The report includes a plan showing the present condition of the works of the Manchester Ship Canal. Water has already been admitted to a point near the River Weaver, and a port has sprung up there during the past six months, which, from its advantageous position for loading Weaver salt, has been named Saltport. Cargoes amounting to 103,957 tons have already been discharged and loaded at Saltport, and the gross total of traffic carried over the opened portion of the Canal (about 11 miles), was 1,124,594 tons during 1892. Out of the total length of 35½ miles of canal, only 1 mile of excavation remains to be completed.

Survey of French Lakes.—In pursuing his researches on the smaller lakes of Eastern France M. Delebecque has investigated the connected series of the Lacs des Sept-Laux in Isère. These form a chain of five on one side of the Col des Sept-Laux and of four on the other. The water passing through these lakes undergoes a series of decantations and, leaving the sediment behind, becomes more and more transparent, the visibility of a white disc in three consecutive lakes extending to 25, 34, and 44 feet of depth respectively. The little Lake of Girotte in Savoy, situated at a height of 5700 feet between the valleys of Beaufort and the Bon-Nant, showed some very curious conditions. Its maximum depth is 54 fathoms, its length about three-quarters of a mile, and its width about one quarter of a mile. Unlike all the other Alpine lakes its water was not found coldest at the bottom in summer. In July the surface temperature was 63° F., the water cooled rapidly to 14 fathoms, where it was between 39° and 40°, then rose again gradually to 45° at the bottom. The chemical nature of the water also differs greatly at different depths. That at the surface contains less than seven parts of solid matter in 100,000 of water, that at the bottom as much as fifty-two parts, the solids being mainly sulphate of lime. The deeper water also contains a perceptible

amount of sulphuretted hydrogen. This presents a certain resemblance to the conditions in the Black Sea (p. 49); but M. Delebecque does not suppose the sulphuretted hydrogen to be the result of decomposing organic matter. He inclines to believe that water charged with sulphuretted hydrogen by contact with mineral sulphides filters into the lake below the surface and so affects the deeper water.

Snowfall in Finland.—The Finnish Geographical Society has organised a system of observations on the thickness of snow in Finland. Observations, made once a week with the aid of a fixed vertical rule placed in a sheltered place, have been sent in from one hundred and sixty-five stations, and the results are now embodied in a paper by A. F. Sundell in *Fennia* (1892, No. 7), as well as in a coloured map which represents the distribution of snow on March 28th, 1891, by means of curves of equal thickness traced at each 10 centimetres (2½ inches). Such charts have been constructed for every week, and the weekly observations have been controlled by the daily observations made at Helsingfors. The weekly observations do not represent the total thickness of fallen snow, which would be obtained if it were measured every day. Thus, the total, deduced from daily observations added together, gives for Helsingfors 43 inches, while the weekly observations only give 29½ inches of snow. The relation between these two figures gives, however, a provisional correction which will ultimately be deduced with more accuracy, from observations which will be made in other parts of Finland as well. The total amount of snow for each separate region is given in a third chapter, and a minute calculation gives for all Finland an average thickness of 24 inches of snow. Each inch of snow (taking into account the just mentioned correction) would correspond to 0·18 inch of water, and this would mean that the total amount of water which is kept in the form of snow over the whole country would represent a layer of 4½ inches of water. The thickest deposit of snow occurred in the extreme south-east, from Lake Saima to St. Petersburg, and in an isolated track running northward along the centre of Finland and just touching the head of the Gulf of Bothnia. For the rest there was a marked thinning of the snow-covering along the coast strip and towards the frontier with Northern Russia.

Glacial Formations in East Finland.—J. E. Rosberg has a paper on the Superficial Deposits in Russian and Finnish Karelia, with especial regard to the Karelian Lateral Moraines, in *Fennia* (1892, No. 7), which is an elaborate contribution to our knowledge of the subject. It also contains valuable materials for the study of the åsar and their relations to moraine deposits, and gives a good deal of information relative to the hydrography and geographical features of the region specially described. It is followed by a summary in German, and is illustrated by two valuable maps.

The Baltic Lakes.—At the tenth meeting of German geographers (Stuttgart, April 1893) Dr. W. Ule, of Halle, read a paper on the temperatures of the Baltic lakes. His investigations have shown that the Baltic lakes differ greatly from the Alpine lakes in the matter of temperature, as in great depths the former are comparatively warm, a fact which is in all probability due to the considerable amount of the underground water-supply. Also the formation of the shores has some influence, inasmuch as lakes with steep shores have lower temperatures. The direct influence of the sun, however, is comparatively of little importance, as is proved by the small daily range of the surface water. (Compare also *Geographical Journal*, 1893, pp. 61–62.)

ASIA.

The Trans-Siberian Railway.—A special Committee, under the Heir-Apparent of Russia, was appointed on March 8th for the supervision of the Siberian railway. At its second meeting the Committee decided that, after having crossed the Ob at the Krivoschekove village, the line will be continued to the town of Mariinsk, and thence to Achinsk, Krasnoyarsk, Kansk, Nizhne Udinsk and Irkutsk. It will thus follow in East Siberia the direction of the present highway which takes the direction indicated by the nature of the country.

Exploration in Siberia.—At the meeting of the Russian Geographical Society on March 22nd, the report of the Government mining expedition was read. The expedition was sent to explore the parts of Akmolinsk and Yeniseisk, which will be crossed by the Siberian railway. It reports that the eastern part of the Oshim Steppe, which is known as the Gorkaya, or Bitter Steppe, and which will be crossed by the railway between Petropavlovsk and Omsk, contains great numbers of salt and bitter lakes, but is almost entirely devoid of fresh water. Geological explorations having been made to ascertain the structure of the Steppe, the expedition came to the conclusion that there will be no difficulty in obtaining water, either by means of common wells or from artesian wells. The forests in the south of the Yeniseisk Government are immense, but the expedition recommends measures for protecting them from destruction—the more so as they will be required in the near future for the mining industry.

Exploration in Korea.—The Rev. L. O. Warner contributes to the April Number of *The Mission Field* an interesting account of a river journey he made in Korea during the months of September and October of last year. A start was made on September 1st from a small village on the banks of the Han called Hangkang, situated about 5 miles to the south-east of Seoul. For 100 miles or so above Seoul the villages on the river banks are reported to be exceedingly numerous. After the first 100 miles the river becomes very shallow, and, owing to the many rapids, almost

impracticable for junk traffic. Between the village of Hangkang and that of Ma-chai (where a large tributary from the north joins the main stream, which flows southwards) a distance of 30 miles, there are at least thirty villages of various sizes, the most important and largest being Tonksyem, the inhabitants of which are mainly engaged in the timber trade. Between Ma-chai and the prefectorial town of Tanyang, a distance of something over 100 miles, there are one hundred and thirty-nine villages including four prefectorial towns, which are situated on the river banks, varying in size from hamlets of three or four houses to a town of three thousand seven hundred, which is the size of Nye-Ju, in the Kyeng-Keni-To Province. Again, between the town of Tanyang, in Chung-Ching-To, and that of Yeng-Choun, in the same province, a distance of about 25 miles, there are only ten riverside villages, this falling off in the numbers being apparently due to the fact that the river is too shallow to admit of much junk traffic. On the banks of the northern arm, which joins the main stream at Ma-Chai, and was ascended as far as the town of Nang Chyen, in the Province of Kang-Wen-To, a distance of slightly under 100 miles, there were found to be eighty villages, including two small prefectorial towns, namely, Ka-Hpyeng, in Kyeng-Keni-To, and Nang-chyen, in Kang-wen-To. Respecting the connection between the town of Tanyang, on the southern stream, in the province of Chung-Ching-To and the River Nak-Tong, Mr. Warner reports that, leaving the river at Tanyang, about 25 miles north of Yeng-Choun, the most southern point reached, he and his party travelled across the mountains into Kyeng-san-To, and made a journey of 60 miles to the town of An-Tong (following most of the way one of the small streams which eventually help to form the Nang-Tong-River). At An-Tong the river is not navigable, but appears to be so at a distance of about 45 miles to the south-west of the latter place. In order, therefore, to connect the two rivers it is necessary to travel slightly over 100 miles overland. The country people who inhabit these river-side villages appear to be mainly engaged in agricultural pursuits. There are to be found, besides, in several of the villages, manufacturers of pottery, china, and large earthenware jars; in others, there are settlements of charcoal-burners; while timber merchants, wood-cutters, and boatmen are frequently met with. At a few of the villages the people manufacture silk in small quantities; while in the district of Nang-Chyen, there appears to be a large industry in the manufacture of wooden bowls. Mr. Warner speaks very favourably of the attitude of the people towards foreigners, and concludes that the River Han may form a very important part of future missionary work in the country.

AFRICA.

The Wakua Steppe, German East Africa.—H. F. v. Behr describes in *Mittheilungen aus den Deutschen Schutzgebieten* (vol. vi. No. 1) a journey made by him in 1891 across the Wakua Steppe, an extensive tract of country between the Rovuma and Rufiji basins. The old caravan route from Kilwa to Lake Nyasa, followed by Roscher on his ill-fated journey in 1859, passed through this country, into which Von der Decken also penetrated some distance, but which has not been since explored. Von Behr's journey was undertaken in order to throw light on the course of the river Umbe-kuru, mentioned by those travellers, as well as to investigate the field for the supply of copal in these parts. Ascending to the Mpatila Plateau from Lindi he first proceeded to the Universities Mission Station Masasi which has never recovered its prosperity since the Magwangwara raid of 1881. From Mount Ntandi, on the slope of which the station is placed, a view was obtained over the wide steppes to the west, with isolated gneiss rocks scattered over their surface. The chief Mashemba, first visited by Livingstone on his last journey,

who for many years was the most active slave-trader in these parts, is still much feared by the natives; but since the restrictions put upon the trade he has had to turn his attention to the collection of indiarubber. The dense thickets with which his village is surrounded enabled him for some time to defy the German authorities, but he has since made his submission. From Masasi Von Behr set out for the Steppe with twenty porters and two Wakua guides. The latter soon deserted, taking with them a large supply of meat, which the leader's wife had supplied the day before, and difficulties now began. A village was luckily met with, and new guides obtained, only, however, to succumb to the same temptation as the former ones. Whilst with the party they had shown a wonderful instinct in guiding it across the trackless Steppe, without landmark, to a solitary water hole. Water at this time of year is only found at long intervals, and the stunted trees being for the most part completely bare the Steppe has a desolate appearance. Trusting at all events to come upon the course of the Umbe-kuru, the party pushed on. Only after leaving a dry river-bed far behind them, and finding no trace of water or of the old caravan route, did the conviction force itself upon them that that dry channel represented the river they were in search of. They were now in an almost desperate situation, with a three days' waterless tract behind them, having already begun to suffer severely from thirst. Retracing their steps they struggled on by night as well as day, the leader finding himself finally quite alone. When almost at the last extremity he was providentially guided to a pool of water by fresh tracks of game, and being joined by his servant made his way back to Masasi, whither all the party but two subsequently arrived in safety.

British Bechuanaland.—The last reports on British Bechuanaland (*Colonial Reports, Annual*, No. 47) show the progress made in the development of the country during the eighteen months ended March 31st, 1892. After the extension of the railway to Vryburg, a large quantity of merchandise for the South African Republic passed through the Colony, but much of this traffic has since been diverted by the opening of the Cape railways through the Orange Free State. Exports too, as far as statistics are available, show a marked increase. A large proportion, it is true, occurs under the head of timber and firewood, involving a deplorable destruction of forest, which cannot be reduced by imposing a duty owing to the free-trade agreement between the different countries of the Customs Union in respect of their own products. A more satisfactory, and still larger increase, is that of grain and cereals exported, mostly from the Bechuanaland Native Reserves, the prosperous condition of which proves the soundness of the policy which created them. Other exports are wool, and mohair (chiefly from the South African Republic), and skins, hides, horns, and ivory from Bechuanaland and the Protectorate. Good progress has been made with the trigonometrical survey, and a comparison with the best geodetic surveys of the world shows the high place it holds among them as regards accuracy. The Surveyor-General reports on the newly-annexed territory of Mier, adjoining the Anglo-German boundary, in which many grants of farms have been made, and much land available for sale still remains. The boundary cuts through David Vilander's country, leaving a portion outside British territory, much to the regret of that chief and his people. There is great scarcity of water, and the sinking of wells has not always proved so successful as has been the case also in Bechuanaland. Since June 1891, a beginning has been made in the collection of Revenue.

Notes on Tripoli.—From a recent Consular Report (Annual Series, No. 1159, 1893) on the trade of Bengazi, in the province of Tripoli, we learn that during 1891 the

exportation of cattle was unusually large, owing to the comparatively slight quantity of rain which fell during the winter months, and the consequent absence of pasturage. It is computed that not less than 19,000 cattle, or more than twice the number exported in 1890, were sent to Malta, Canea, and Alexandria, while about 400 horses and over 8000 sheep were sent to the same ports by sea, a still greater quantity of sheep going to Egypt by land. The report also states that a considerable trade is carried on with Wadai and other countries of the Central Sudan by means of caravans, which bring to the port of Bengazi large quantities of ivory and ostrich feathers, taking in exchange chiefly British cotton goods. This traffic, however, towards the close of 1891 began to be endangered owing to the attacks of tribes in revolt. The caravan route from Derna to Egypt is also unsafe from a similar cause. During the last five years the yield of salt at Bengazi has gradually increased, although during the same period there has been a considerable decrease in the amount sold. There has also been an increase during 1891 in the number of sailing vessels and boats employed in the sponge fishery, more especially in the case of those hailing from the Greek Islands. In its present isolated condition, owing to the want of a telegraph, there appears to be no hope of any regular development of trade at Bengazi.

Beira, South-East Africa.—Some interesting particulars regarding the present condition and future prospects of the Portuguese port of Beira in South-Eastern Africa are given in a recent Consular Report (Annual Series, 1893, No. 1163). The town of Beira, which dates its existence only from the beginning of the year 1891, is situated at the mouth of the Pungwe, and is the headquarters of the territory administered by the Mozambique Company. When the Pungwe River was first adopted as the best route into Mashonaland, a few stores were started here, and since then the town has rapidly developed. No regular census has yet been taken, but the population is assumed to be from 700 to 800, 200 being Europeans. A railway that is to bridge the "fly country" is now in course of construction from Beira, and on its completion will enormously increase the trade with the interior, forming, as it will, the highway into the British possessions of Mashonaland. The country around Beira is said to be full of game. There is a good safe harbour, and the climate, although hot, is equable. The name Beira signifies "bar," and has reference to the low sand ridge on which the town is situated.

AMERICA.

Exploration in Canada.—The work of the Geological Survey of Canada during the coming summer is to include two explorations possessing more than the usual amount of geographical interest, being directed to some of the extensive regions of the northern part of the Dominion which still remain practically unknown, and for which the indications appearing on the maps are little more than conjecture. Mr. J. B. Tyrrell, F.G.S., is to examine and report upon the country between Lake Athabasca and the western shore of Hudson Bay, the objective point on the bay being in the vicinity of Chesterfield Inlet. The greater part of the route proposed will traverse the "Barren Grounds," and it is hoped that it may be possible definitely to fix the main geographical outlines of that region, which are at present known only in the most imperfect way from sketches made by Samuel Hearne more than a hundred years ago. The second of the explorations is to

be carried out by Mr. A. P. Low, who, after reaching Lake Mistassini (the vicinity of which he has already examined), will follow the East-main River to its head, cross the watershed to one of the large rivers which are known to flow northward in the interior of the Labrador Peninsula, and descend this to Ungava Bay, on Hudson Strait. It is probable that Mr. Low will winter at Ungava, and return in 1894 to Hamilton Inlet by a different route. In explorations like these, geographical and geological work necessarily go hand in hand, and it is to be anticipated that their result will be to enable considerable additions to be made to the general geological map of Canada.

The Alaskan Boundary Survey.—The Alaskan Boundary is one of the many disputed questions which are the natural corollary of our widely-extended empire. The dispute in question is between the United States and Canada, and bearing the well-known and somewhat similar San Juan controversy in mind, it may be hoped that it will be quickly and amicably settled. For the purposes of final delimitation, the United States and Great Britain have now agreed, since the exchange of ratifications at Washington in August 1892, that "a coincident or joint survey (as may in practice be found most convenient) shall be made of the territory adjacent to that part of the boundary line of the Dominion of Canada and the United States of America, dividing the Province of British Columbia and the North-West Territories of Canada from the Territory of Alaska, from the latitude of 54° 40′ N. to the point where the said boundary-line encounters the 141° of longitude westward from the meridian of Greenwich by Commissions to be appointed severally by the High Contracting parties with a view to the ascertainment of the facts and data necessary to the permanent delimitation of the said boundary line in accordance with the spirit and intent of the existing treaties in regard to it between Great Britain and Russia, and between the United States and Russia." On this survey the Government of Canada will be represented. Alaska, with its estimated area of 580,000 square miles and broken coastline, was the hunting-ground of the Imperial Russian Fur Trading Company from 1799 to 1867. In that year the Territory, with all frontier difficulties attaching to it, was bought from Russia by the United States for 7,200,000 dollars. The whole boundary-line naturally falls into two sections, one of which begins from the southernmost extremity of Prince of Wales Island, ascends the Portland Channel, and, passing along the range of mountains, meets with the 141° of longitude west of Greenwich, and it is with this section that the present joint commission is concerned. The other section is the 141st meridan itself, which is followed until the Arctic Sea, or, as it is termed in the treaty, "The Frozen Ocean," is reached. Here at Demarcation Point, not far from the mouth of the Mackenzie River, is the northernmost limit between Alaska and the North-West Territories of Canada. There is not much dispute about this latter section, the line being capable of astronomical definition, and in 1869 Captain Raymond of the United States Engineers, whilst engaged on a survey of the Yukon, was able to determine accurately the position of the old Fort Yukon, a trading port of the Hudson Bay Company. He proved that the old station was really in Alaskan territory, so the fur-traders retired up the Porcupine River to a point about which there was no doubt. In the spring of 1889 two parties were organised from the United States to ascend the River Yukon and its branch, the Porcupine, from Bering Sea with the object of establishing camps along the line of the 141st meridian in order to make astronomical observations, one party under Mr. J. E. McGrath, taking the boundary south of Fort Yukon, and the second party under Mr. J. Henry Turner, taking the boundary

north of Fort Yukon to the Frozen Ocean. The results of their observations are embodied in the February number of the *National Geographic Magazine*. This, of course, was not a joint commission, but simply an expedition conducted by the United States Coast and Geodetic Survey. It is clear that the task of the present joint commission in settling the boundary-line on the south-east corner of Alaska amongst the island groups is more difficult. This in 1791 was the scene of the surveys by Captain George Vancouver, who searched the numerous islands and sounds for the long-desired water communication between the North Pacific and Hudson Bay, proving once for all that a "north-west passage" did not exist there. Subsequent boundaries and geographical definitions have been largely founded on his inferences. Dr. T. C. Mendenhall stated that the treaty defines the line as beginning at the southernmost extremity of Prince of Wales Island, which point *was supposed to lie* (the italics are ours, and the supposition Dr. Mendenhall's) on the parallel of 54° 40′ N. latitude, thence it shall ascend the Portland *Canal* (?) until the 50th parallel of north latitude is reached. From this point it shall follow the line marked by the summits of the range of mountains parallel to the coast until such line meets with the 141st meridian. In a supplementary note it was agreed that Prince of Wales Island should belong to Russia, and so now to the United States. It was also agreed that whenever the summit of the range of mountains referred to shall be at a greater distance from the coast than ten marine leagues, the limit of Alaska will be found by a line parallel to the windings of the coast, and never more than ten marine leagues from the shore. Dr. Mendenhall doubts the existence of this range of mountains, and so it will be necessary to fall back upon the second definition of the boundary line. To settle this as well as to determine the exact position of Prince of Wales Island will be, apparently, the chief task of the joint commission.

The Proposed New Capital of Brazil.—Last year the Brazilian Government sent an expedition into the interior for the purpose of fixing on a suitable site for the new national capital. Ernst Ule, naturalist of the National Museum at Rio de Janeiro, gives some account of the journey in the April number of *Petermann's Mitteilungen*. The Government set apart the sum of £20,000 for the expedition. Besides the eighteen members of the Commission, comprising doctors, meteorologists, geologists, astronomers and engineers, there were soldiers as escort and servants, which brought the number up to forty, with over one hundred and eighty horses and mules. The region explored lies to the north-west of Rio de Janeiro. It forms part of the Brazilian highlands, averaging 2000 feet in height. It is a rolling country covered with stunted trees and grass. Only in the river valleys is there a more abundant forest growth. The population is extremely sparse and the inhabitants are poor and lazy. Whether the expedition will fulfil its object of finding a suitable site, and if so, whether the new national capital will be a success is extremely doubtful. The scientific results of the expedition however seem likely to prove of some value.

Roads in Ecuador.—Mr. Haggard's recent Report on Ecuador (Foreign Office, Annual Series, 1893, No. 1146) attributes the backward condition of the country, mainly owing to the want of proper means of communication. At the present time the so-called roads are nothing but mule-tracks, which are

practically closed during the rainy season, which lasts for a great part of the year. In many places the only available tracks are the beds of the deep torrents formed in the loose volcanic soil, while in others a way has to be forced through miles of deep mud produced by the same cause. During the winter months it appears to be almost impossible for travellers, and quite so for merchandise, to pass even over the main track from Guayaquil to Quito, though in some places efforts have been made to make a real road of this. It will thus be seen that the interior of Ecuador is entirely shut out from commerce during about half of the year, and the resources of the country remain therefore almost wholly undeveloped. Ecuador is said to be one of the richest countries of the world. In the uplands the products of temperate climates flourish luxuriantly even under the present primitive system of agriculture. Near Quito, and in many another upland valley there is magnificent pasturage for cattle, while barley, wheat, maize, etc., grow luxuriantly; in a valley within only three hours' ride, tobacco, the sugar-cane, oranges, etc., flourish equally. Ecuador appears to be also rich in metals of all kinds. Mr. Haggard is of opinion that when a line is under serious consideration it will be found advisable to construct it to the interior, taking Bahia or Pailou, a place on the Colombian frontier, as a starting-point, rather than Guayaquil.

AUSTRALASIA AND PACIFIC ISLANDS.

Death of a New Zealand Explorer.—Intelligence has reached us of the death by drowning of Quentin Mackinnon, a well-known explorer and guide of the region surrounding Lake Te Anau in Western Otago. He discovered a pass now called by his name, by which tourists may pass from Milford Sound on the west coast to the picturesque lake region of the south-eastern slope of the Southern Alps. On this route a fine waterfall on the Clinton River was discovered by and named after Mackinnon.

Exploration in Central Australia.*—Although the important expedition, equipped by the liberality of Sir Thomas Elder, for the purpose of completing the exploration of the interior of Australia, has been unable to accomplish all that was expected of it, yet a glance at this map, which has been produced at the Surveyor-General's Office, Adelaide, will show that our knowledge of the geography of this portion of Australia has been considerably increased by the careful work done by the commander of the expedition, Mr. David Lindsay, and his assistants Messrs. Wells and Streichs. The new work, shown on the map, in the Colony of South Australia, is included between the latitudes 27° S. and 28° 20′ S., commencing on the east at the Everard Range, and crossing the western boundary of the colony at the Blyth Hills. The country within these limits appears to have been very thoroughly explored, the track showing that it was traversed in all directions. In Western Australia, Mr. Lindsay first proceeded from Blyth Hills in a north-westerly direction to a point about 20 miles

* Map showing the explorations and discoveries in South Australia and Western Australia, made by the Elder Scientific Exploring Expedition, commanded by David Lindsay, F.R.G.S., etc., 1891–2.

north of Mount Squires, and from thence proceeded in a direct line for Victoria Springs. From this point the track on the map shows that he travelled nearly due south as far as the Fraser Range, and then in a north-westerly direction until he reached Mount Monger in the neighbourhood of Lake Lefroy, and it is at this point that the explorations for the year 1891 came to an end. The explorations of Mr. Lindsay and his party in the Eastern Division of West Australia in 1892, are shown on the western sheet of this map. On this occasion he started from a position about sixty miles south-west of the Kimberley Range, and, travelling towards the west, reached a point in latitude 27° 55′ S., longitude 124° E.; here he turned northwards, returning to the place from which he set out by a route about 60 miles to the north of that followed by him on his outward journey. The map is unusually complete in detail, and is covered with notes on the geology, physical geography, and nature of the country. The physiographical notes have been taken from the geologist's (Mr. Streich's) diary, except for the country between longitudes 119° and 125°, latitudes 26° and 28°, which are by Professor Tate from specimens collected by Mr. Wells. All camping places, trigonometrical stations, and water-holes, are indicated by symbols, and the routes of previous explorers are also laid down.

Triangulation of North-West Portion of South Australia.—The South Australian Government has recently issued Reports by Mr. J. Carruthers of his triangulation of portions of the north-west of South Australia. A summary has already been given of the first Report, which treats of the country triangulated in Everard, Musgrave, Mann, and Tomkinson Ranges, and Deering Hills, during the years 1888, 1889, and 1890.* The second Report deals with the country triangulated south of the Everard and Musgrave Ranges during 1891–92, and embodies a short description of the journey and the character of the country passed over. On this occasion the first and only depôt was formed at Indulkana Springs; and from here the country was triangulated westward from the existing previous triangulation west of the overland telegraph line. This tract of country, comprising about 5000 square miles, took nearly eight months to complete. That portion immediately south-east of the Indulkana Springs is described as chiefly open, stony tablelands, intersected by numerous creeks and watercourses, the vegetation in the valleys being cotton and salt bush, and good grass and herbage, with acacia, wattle, and myall. The country south and south-west of Indulkana and west of the Everard Range is chiefly sandy flats and sandhills covered with mulga scrub, wiry, and tussocky grasses, parakelia, sage-bush, and patches of salt-bush and other herbage. The most important waters found were the Oolarinna wells (native). The work was afterwards extended towards the western boundary of the province, where, during a period of ten weeks, 6000 square miles of country were triangulated, and 990 miles traversed. The country representing the above area chiefly consists of sandhills and sandy flats, covered with mallee, mulga, quondong, sage-bush, spinifex, and various shrubs and bushes, with belts of *Casuarina* (desert oak), and scattered poplar, pine, bloodwood, cork, and currajong trees. Between latitude 26° 40′ and 27° 30′ S. high granite hills are scattered about, averaging from 100 feet to 900 feet above the

* *Vide Proceedings*, 1892, p. 181.

level of the surrounding country. The work was further completed as far as Mount Barry, during which 1000 square miles of country were added to that already completed. An examination was also made of the country west of Eeavinna and England's Hill to the margin of the tablelands westward. Since leaving Adelaide on July 10th, 1891, to the departure of the party from Appreetinna Wells, Sept. 15th, 1892, no rain is said to have fallen.

The Great Rains in Queensland.—Mr. Clement L. Wragge writes as follows with regard to the recent remarkable rainfall which preceded the Queensland floods (see p. 239):—I send a few particulars of the recent remarkable rainfall at Crohamhurst, situated on the western slope of Mt. Blanc, a peak on a spur of the D'Aguilar range, an offset from the Blackhall Ranges, South-Eastern Queensland. The whole of this district is watered by the Stanley River, a tributary of the Brisbane River, and hence the values given below were prominent factors in producing the terrible floods from which we have suffered. I may mention that the observer at Crohamhurst is Mr. Inigo Owen Jones, one of my specially trained assistants, and that implicit reliance can be placed on his figures. The following are the more phenomenal falls for the flood period at Crohamhurst:—for twenty-four hours ending 9 a.m. Feb. 1st, 10·775 in.; ditto, Feb. 2nd, 20·056 in.; ditto, Feb. 3rd, 35·714 in.; ditto, Feb. 4th, 10·760 in. The gauge is a standard of the "8-inch" pattern, standing 1 foot above the ground, at an altitude of about 1400 feet above mean sea-level. The approximate latitude and longitude of Crohamhurst are 26° 50′ S., 152° 55′ E. The gauge was emptied every three hours, night and day, on the occasion of the greatest fall. I think meteorologists will agree that for a twenty-four hours' fall we have beaten the world's record.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

New Researches on the North Sea.—The Swedish and Danish Governments have supplied funds to enable Professor Pettersson of Stockholm to continue his researches into the physical condition of the water in the Skagerrak, Kattegat, Western Baltic, and eastern part of the North Sea. The first set of observations was made on May 1st, and they will be repeated on August 1st and November 1st, 1893, and on February 1st and May 1st, 1894. It appears probable that the Fishery Board for Scotland, which has for several years carried out valuable systematic observations along the western margin of the North Sea, may co-operate with the Scandinavian observers by choosing the date for a cruise already being planned, so as to ensure observations between the north coast of Scotland and Shetland being made simultaneously with those under Professor Pettersson's charge.

Oceanographic Work by Russians in Eastern Asiatic Waters.—Admiral Makaroff, of the Russian Navy, has given in *Petermann's Mitteilungen* for April an account of the oceanographic work done by the corvette *Witja* under his command during a voyage round the world. The *Witja*, bound for the east-Asiatic station, left Cronstadt in September 1886, reached the Sandwich Islands by way of Cape Horn in March, and Yokohama in April 1887. The summer was spent in cruising about the Japanese seas and the Sea of Okhotsk, the winter in the China Sea and the vicinity of the Philippines. In August 1888, we find the *Witja* in Bering Sea, before starting

home by way of Hongkong, Singapore and Suez. Cronstadt was reached in May 1889. Not much scientific work could be done till the *Witja* reached her station, but once there, Admiral Makaroff set to work with most commendable energy, and the results of his work, which will shortly be published in full, will prove a valuable addition to our knowledge of eastern Asiatic waters. Makaroff's remarks on the currents of these seas are highly interesting. It would appear that the Central Pacific drift strikes the eastern shores of the Philippines and is split into two branches. Of these the smaller goes south-west and south, the larger, forming the Kuro Shiwo, goes north and north-east, surrounding Formosa with its warm salt-laden water. It does not touch the mainland, being separated therefrom (at any rate during the prevalence of the south-west monsoon) by a current of water with a much smaller proportion of salt than the Kuro Shiwo, and flowing south from the Formosa Strait. The Kuro Shiwo flows towards Korea and splits on its southern point, a small current losing itself in the Yellow Sea, while the great mass surrounds Japan. On the south coast its influence is felt as far as Yokohama, from which point it takes an easterly turn. The current of the Korea Strait follows the coasts of Japan and Sakhalin, finding outlets in the Straits of La Perouse and Sangar. In the Sea of Okhotsk, Makaroff found a current running north along the west coast of Kamchatka, then west, and lastly south along the east coast of Sakhalin. It would appear, then, that Schrenck's statements regarding this region are incorrect. Makaroff attempts to explain the existence of the Oya Shiwo, the cold stream of the Kuriles. He is of opinion that tidal movements stir up the shallow waters of the inland seas, and cause their warm water to mix with the cold water of greater depth. The Shantar Islands, in the south-west corner of the Sea of Okhotsk, have long been noted for the length of time during which drift ice is seen there. Admiral Makaroff supplements this by the statement that on August 3rd he saw large masses of drift ice near Staritzki, at the north end of Sakhalin, while small quantities were visible as late as August 24th.

Observations on Ocean Currents and Waves.—At the meeting of the Geographical Society of Berlin, on January 7th, Dr. Schott read a report upon the results of the scientific observations during a voyage which he made last year on board a large four-masted sailing vessel. It appears that south and east of the Cape of Good Hope, between 20° and 53° E., there is not merely a current drifting eastwards and advancing in the train of the boisterous west winds, but also a cold Polar current, coming from the south, which is predominant. That this is so, is evidenced by the abnormally low water temperatures, the low salinity, and the northerly set of the current, as well as by the numerous floating icebergs. The striking differences of temperature which occur in short distances are, as regards the western part, to be ascribed to the warm Agulhas current; further east and north of Kerguelen Island, to the Madagascar current, which is remarkable for the great extent of its waters rather than for the absolute height of its temperature; along these longitudes there is, therefore, an absence of icebergs. This Madagascar current bears the same relation to the Agulhas stream as the Antilles current does to the Gulf Stream. It would appear as if all *intensive* but restricted oceanic currents are accompanied by a second *weaker*, but far more extensive, current. The more recent investigations as to the Kuro-Shiwo point to a similar phenomenon there. As regards the latter current, all the maps appear to represent it, in its course between Formosa and Japan, too far to the east. It flows for its whole extent west of the Lu-Chu Islands. Its left margin towards Asia is very sharply defined against the cold stream that flows along the Chinese coast, while its eastern border, like that of the Gulf Stream, is indistinct, and in some places

unrecognisable in consequence of the effect of the Earth's rotation. In the southern hemisphere, in the case of the Agulhas current, the observations show that its left margin is, like the right edge of the Kuro-Shiwo, indistinctly defined. A moderate trade wind causes waves, the length of which, from crest to crest, is about from 38 to 44 feet, the period from 4½ to 5 seconds, and the velocity 58 feet a second, or 16¾ miles an hour. Big storm-waves on the other hand move at the rate of 40 miles an hour, and attain a length of 220 feet. No matter what the force of the wind was, the velocity of the wind was found, by Dr. Schott, to be in every case considerably greater than that of the waves. The relation of the height of the waves to the velocity of the wind is subject to very important variations. The height of the waves increases with the strength of the wind, not in simple proportion but in a hyperbolic ratio. Storm-waves rise at a greater angle than ordinary waves; the proportion between the height of the wave and its length is, on a rough sea, as 1 to 18, on a moderate sea, as 1 to 33. The highest waves measured with an aneroid provided with a micrometer, attained an elevation of 32 feet. It may, therefore, be said that even in the most violent storms on the open sea, waves of more than 50 feet are very rarely met with. For ascertaining the salinity of the ocean the refractometer, constructed by Professor Abbe, of Jena, proved to be of inestimable value during rough weather, and Dr. Schott recommends this instrument in the highest terms to future marine expeditions. The results of observations with Assmann's "aspiration thermometer" show that the temperatures formerly obtained from ships' observations in tropical waters are fairly correct, in cases where the thermometer was properly fixed and the rapid circulation of the air taken into account; during a calm much too high temperatures have been observed. On the other hand, the more extensive use of Assmann's "aspiration thermometer" will have the result of reforming very considerably our notions as to the humidity of the air of the tropics. The relative humidity will probably turn out to be about 15 per cent. less than is usually supposed.

Jäderin's Apparatus for the Measurement of a Base-line.—The seventh number of *Fennia*, the Finland Geographical Society's Journal, contains an important paper in French, by A. Bonsdorff. The triangulation which was made in 1886 and 1887 both in Finland and in Esthonia necessitated the measurement of a new base-line in addition to that of Pulkovo, and the place for it was chosen to the west of Pulkovo between Moloskovitsy and Ozeritsy. It has a length of 32,225 feet (about 6 miles), and was measured by Jäderin's apparatus. The apparatus consists, as is known, of metallic cords of 82 or 164 feet (25 or 50 metres) each, the exact length of which and dilatation coefficients are ascertained with great accuracy by comparison with standards at different temperatures. The wires, which have soldered to each end a short piece of tube finely divided into millimetres, are attached by their ends to tripods, and are stretched by dynamometers with a force of 22 lbs. Six cords are used, each separate measurement being made with two of different metals (steel and brass) so as to counteract the effects of temperature. The apparatus is previously tested by measuring some known base (Pulkovo in this case), and the lengths of the cords are verified again (after the measurement has been completed to ascertain the possible changes due to time). The rapidity of work with Jäderin's apparatus is such that the Moloskovitsy base, although six miles long over broken country, where steel bars could not be used, was measured twice in the course of only seven days. The average speed was thus over 9000 feet per day, and on one day a length of 19,700 feet (nearly 4 miles) was measured, thus giving the highest record ever attained with any apparatus. The accuracy of the measurements may be seen from the following table, giving the differences between

each of the separate measurements made by the apparatus of Struve and that of Jäderin, and the average length deduced separately from each series—

Struve.		Jäderin.	
	millimetres.		millimetres.
1870	+ 0·5	July 29	+ 6·2
„	− 6·3	August 3	− 1·4
1872	+ 3·4	„ 14	− 4·8
„	− 4·5		
1876	+ 7·0		

The first column shows larger differences than the second, and M. Bonsdorff thus concludes that the different measurements with Jäderin's cords agree better together than those obtained by the apparatus of Struve.

Berzelius on the Variations of Sea-level.—S. Günther has lately (*Ausland*, 1893, No. 9) called attention to a remarkable anticipation of modern theory in the province of geo-physics, on the part of the great Swedish chemist Berzelius. Having turned his attention to changes of sea-level on the Scandinavian coasts, he propounded his views in his annual report on the progress of Physical Science (1835). He found an explanation in the lessening of the Earth's diameter owing to cooling, which, he said, would cause an irregular falling in of the crust, some parts being raised and others sinking. This exactly agrees, so far as it goes, with the latest views of Suess on the subject. Little notice, and that unfavourable, was taken of the theory at the time, but the objection from the supposed shortening of the length of the day involved has been set aside by recent investigations.

GENERAL.

The Humboldt Medal of the Berlin Geographical Society.—The Humboldt Gold Medal was instituted in 1878 as the highest award which the Berlin Geographical Society could confer on an eminent geographer. Until this year it was only once awarded, General Prjevalski being the recipient. The second award has just been made to Dr. John Murray as the senior surviving member of the scientific staff of the *Challenger* in her great circumnavigation. The medal was intended to do honour to the memory of Humboldt by the recognition of work done in the spirit of that great pioneer, especially the comprehensive discussion of material collected on exploring journeys and serving to advance the scientific knowlege of the Earth. In announcing the award Baron von Richthofen said that looking back at the great geographical achievements of the last decades, he could see nothing which so admirably embodied the spirit which this prize was intended to foster as the voyage of the *Challenger*. Now after twenty-one years the results of that great voyage had been discussed and published in a set of gigantic volumes, a storehouse of rich and varied knowledge, fruitful in results alike to the practical and theoretical sides of physical geography.

Colonel R. W. Stewart's "Panoram."—A photographic camera, which it seems probable will in the future play an important part in the mapping of unsurveyed countries, has been invented by Col. R. W. Stewart, R.E., and Mr. Tweedy of Plymouth. It has the advantage of being smaller than an ordinary camera of the same capacity, and is also lighter, all the fittings being made of aluminium. It is easy to manipulate, and not likely to get out of order. The instrument consists of a rectangular box, whose length from back to front is a little more than the focal length of the lens to be used; its height is somewhat greater than the width of the film (for an 8-inch spool the height would be just 9 inches), and the breadth is a fixed dimension of 5 inches for all sizes. This camera rests on a circular disc, forming the head of the tripod-stand; to the bottom of the box is screwed, in a central position, a tubular arbor fitting into a socket in the disc, and the camera revolves freely on the stand; the box opens down one of its vertical edges, so as to give access to the hinder part of the camera or roll-holder: in this roll-holder are fixed four vertical rollers. The first of these has the tissue supplied by the Eastman Company wound on it; the second and third rollers serve to keep the film in the focal plane, and the fourth, which is called the winder, is actuated by a clock motion, with fly escapement, placed in the front part of the camera, the fly being normally blocked by an arm actuated by a pneumatic ball and tube of the ordinary kind. When required for use the camera is set up on its stand and levelled, the clock is wound up, the slit aperture adjusted, and a suitable stop put in; the camera is then turned round till it points to the left hand of the view required, the pneumatic bulb is squeezed when the clock starts working, and the camera begins to rotate, and continues to do so until the right-hand corner of the view is reached; the bulb is then relaxed; the clock stops, and the camera ceases to revolve. This is but a very general description of this ingenious instrument, which if used at each end of a base will give the angles between all objects photographed. The speed of rotation of the camera itself, and the rollers on which the film is wound, being all actuated by one motor and connected with one another, the ratios of motion must remain the same, and as the rates of such motion can be regulated by altering the ratio of the diameters of the roller and its pulley, it follows that the true rate of motion can be found. In the larger form of camera the films are rather more than 5 feet long, when photographs of the whole circle are taken, in which case they are developed by being primed on to the periphery of a drum, mounted on a horizontal axis, the sensitive surface just dipping into a dish holding the developer, the drum is then rotated until development is complete.

Geography Teaching in Birmingham.—Geography has received a certain amount of attention at the ancient Universities and in some University Colleges on account of the action of the Royal Geographical

Society in urging the importance of the study and in paying a large proportion of the lecturers' salaries. It is extremely gratifying to find that for several years systematic courses of instruction in physical and political geography have been given by Professor C. Lapworth, F.R.S., at the Mason College, Birmingham, in connection with his Chair of Geology. The lectures are very well attended, more than eighty students being enrolled for the present summer course. The lectures are now arranged in two courses on the Principles of Geography, about sixty lectures being given in each. In the Calendar of the Mason College for the current year, Professor Lapworth says :—"These courses of lectures embrace (1) a summary of the chief facts known concerning the present *Surface Features*, and the grander *Natural phenomena* of the 'world we live in'—its lands, its waters, its climates, and its inhabitants; (2) a study of the *Agents of Change*, organic and inorganic, which have brought about the present form and characteristics of its visible surface, and the distribution and arrangement of its living creatures; (3) with a brief sketch of the *Past history* and changes of the Earth's surface, and (4) an investigation of the present relations of this surface *to Man and his works*, his industries, his commerce, his distribution and progress, in so far as they can be traced through the outlines of the political geography of the present day. In other words, the special aims of the lectures are :—first, to give the student a general knowledge of the present physical features, the climates and productions of the Earth; next, to show how all these probably came into being, and how they are in continual process of change and development, and finally to show how man himself is related to the phenomena of the Earth upon which he dwells, how he has peopled its surface, and how he has availed himself of its productions." The first or elementary course is on Physical Geography, divided into (1) the Earth of the present in its relations to astronomy and mathematics, and with regard to land, sea, air, and living creatures; (2), the Earth of the past, comprising an account of the agencies producing surface change, and the processes by which the continents have assumed their present form. The senior course on Political Geography deals with the relation of man to the Earth and then summarises the actual conditions of this relation in the various continents with fuller details concerning the geography of certain countries selected as being typical. Throughout the instruction the effort made is to impress principles and induce the student to apply these to details which he seeks for himself in maps and books.

A Chair of Geography at Tübingen.—At the tenth meeting of German geographers at Stuttgart, in April, it was suggested by Count Carl von Linden, Baron von Richthofen, Professor Kirchhoff, and other eminent German scientists, that a Chair of Geography should be established at the famous South-German University of Tübingen. In response

to this suggestion the King of Württemberg expressed himself entirely in accord with the opinions brought foward, and declared his willingness to take the necessary initiatory steps in the matter. Accordingly a motion was at once put to and accepted by the Landtag. This result is due to the gentlemen mentioned above, especially to Count Linden, who, for years past, has with indefatigable energy and with great success promoted the interests of geography in South Germany. Hence geography is now taught at nineteen of the twenty-one German universities, Rostock and Heidelberg being the only ones which are still without geographical instruction. The total number of teachers, including professors and privat-docenten of geography at German universities, is at present over forty.

The Maps of Apianus.—Professor H. Wagner examines carefully into the existence of the maps of the world ascribed to Peter Apianus in a memoir entitled 'Die dritte Weltkarte Peter Apians v. s. 1530 und die Pseudo-Apiandsche Weltkarte von 1551' (Nachrichten von der K. Ges. der Wiss. zu Göttingen, December 28th, 1892). The first of these maps (Tipus Orbis universalis) accompanies Cramer's edition of 'Solinus,' which was published at Vienna in 1520, as also Vadian's edition of 'Pomponius Mela' of 1522. The second (Mappa mundi) illustrated the 'Declaratio et Usus Typi Cosmographici' of 1522, and is lost. The third map (Universalien cogniti Orbis Tabula, 1530) is now in the British Museum, and Professor Wagner promises to publish a facsimile of it. It is on the equivalent cardiform projection of Stabius and Werner, and in every way superior to the map of 1520. No other maps of the world can be traced to Apianus. That which accompanies the Antwerp edition of the 'Cosmographia' (1544) is undoubtedly by Gemma Frisius, and has been reproduced in the Paris edition of the same work (1551).

OBITUARY.

John Bartholomew.—Mr. John Bartholomew was born in Edinburgh on December 25th, 1831, and at an early age he commenced to learn map-drawing and engraving under the superintendence of his father, who had established a geographical business. Making rapid progress in his work Mr. Bartholomew came to London to act as assistant to the eminent geographer, Dr. Petermann, by association with whom he acquired an enthusiasm for thorough and accurate work which he retained to the end. Returning to Edinburgh in 1856 Mr. Bartholomew carried on his father's business, which rapidly increased on account of the care and attention bestowed on every detail of map production. Atlases arranged and produced by Mr. Bartholomew have been published by a great many publishing firms in the United Kingdom and in other countries. Mr. Bartholomew's name is specially associated with a series of reduced ordnance maps of Scotland and England on the

scales of 4 miles and 2 miles to an inch. On this work he spent many laborious years, although aware that it was in some respects in advance of the requirements of the public, and some of his best geographical work must have resulted in financial loss. In 1889 Mr. Bartholomew retired from active work, leaving the management of his greatly-expanded business to his son, Mr. J. G. Bartholomew, who, following out his father's training, has succeeded to some extent in educating as well as supplying the public demand for maps.

Mr. Bartholomew became a Fellow of the Royal Geographical Society in 1857. He was retiring in disposition, but the genuine kindliness of his character was felt and appreciated by all with whom he came in contact. The gradual failing of health which had been going on for some years necessitated a visit to London, where he died on March 29th, 1893.

William Cotton Oswell, who died on May 1st at Groombridge, near Tunbridge Wells, aged seventy-five years, went to India as a young man, but the climate proved a barrier to a successful career in the Madras Civil Service, and he was ordered to the Cape in broken health. It is more than half a century since Oswell landed in Capetown, and he was amongst the earliest English sportsmen to visit the plains of the interior, where his health was rapidly re-established. He spent the greater part of five years in South Africa, during which his adventures were of the most varied and thrilling kind, and in his later life he never wearied of telling the exploits of his companions and himself as they were recalled by the fine heads of big game which adorned his house.

When he was in Africa, vast herds of game of every kind roamed over tracts that are now the sites of busy towns, or occupied by sheep-farms, where antelopes are now rarer than lions were then. The Kalahari desert was looked upon as an impassable barrier against advance from Cape Colony northward. Livingstone was fortunate enough, in his early travels, to secure the companionship of Oswell, who looked after the waggons, kept the party in food, and enabled his friend to carry on his work of surveying, making scientific collections, and studying the native peoples in freedom from the minor troubles of a wandering life. In 1849, when Livingstone determined to investigate the truth of rumours as to a great lake in the Kalahari, Oswell and his friend Mungo Murray returned to South Africa from England, in order to take part in the exploration, of which indeed they bore the greater part of the expense. The result was the discovery of Lake Ngami, and the important practical demonstration that the Kalahari could be crossed by oxen and waggons. For his part in this journey Oswell received a silver medal from the Paris Geographical Society.

Mr. Oswell was a fine example of the best type of adventurous sportsmen. He was singularly handsome, lithe in figure, knightly in bearing, utterly fearless, and beloved by all the South African travellers of his day. He had a constitutional shrinking from publicity, and never even wrote for publication, although he spared neither time nor trouble in revising and elaborating the books written by his friends on subjects with which he had made himself familiar. He joined the Royal Geographical Society in 1852, and served on the Council in 1855, although he could rarely be induced to take part in the public meetings of the Society.

After leaving Africa, Mr. Oswell travelled extensively in South America and elsewhere. For many years he resided quietly at Groombridge, unknown to the general public, but the centre of a great circle of warm personal friends, to whom his unfailing geniality and delicate consideration endeared him in an exceptional degree. He is survived by a widow and family.

MEETINGS OF THE ROYAL GEOGRAPHICAL SOCIETY, SESSION 1892-93.

Eleventh Ordinary Meeting, April 24th, **1893.—The Right Hon. Sir MOUNTSTUART E. GRANT DUFF, G.C.S.I., President, in the Chair.**

ELECTIONS.—*Colonel H. Cautley, R.E.; J. C. Clancey; Walter Clifford; Rev. J. J. B. Coles, M.A.; Lieut. Francis John Davies (Grenadier Guards); George Frederick Edwards; Robert Glennie; Commander Charles Harvey; Joseph Hinchliffe; Charles W. May; James R. Renton.*

The Paper read was:—

"Journeys in French Indo-China." By Hon. G. N. Curzon, M.P.

There was an exhibition of photographs in the tea-room.

Twelfth Ordinary Meeting, May 8th, **1893.—The Right Hon. Sir MOUNTSTUART E. GRANT DUFF, G.C.S.I., F.R.S., President, in the Chair.**

ELECTIONS:—*Arthur Bird; Thomas Benjamin Bowring; Ellis Carr; Rev. C. C. Childs, M.A.; Rev. Charles Cook; William Alfred Eckersley; Arthur Greg, J.P.; Edmund W. Janson, B.A.; John Revilliod; Frederick Charles Smith; Walter J. Stanford; Robert M. W. Swan; Surgeon-Major L. A. Waddell (Bengal Medical Staff); Peter F. Wood.*

The Paper read was:—

"Exploration and Climbing in the Karakoram Mountains." By W. M. Conway.

There was an exhibition of photographs and paintings in the tea-room.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By HUGH ROBERT MILL, D.Sc., *Librarian*, R.G.S.

EUROPE.

Balkan States. **Pimodan.**

Le Capitaine de Pimodan. De Goritz à Sofia. Istrie, Dalmatie, Monténégro, Grèce, Turquie, Bulgarie. Paris, Champion, 1893: 8vo, pp. 212. *Price 5 fr.*

A bright and pleasant diary of a four months' tour through the Balkan States.

Black Sea. *Bul. Acad. Imp. Sci. St. Petersburg* **35** (1893): 437–448. **Andrussow.**

Sur l'état du bassin de la mer Noire pendant l'époque pliocene. Par N. Andrussow.

Black Sea. **Pereyaslawzewa.**

Monographie des Turbellariés de la Mer Noire. Par Dr. Sophie Pereyaslawzewa. Odessa, A. Schultze, 1892: 8vo, pp. xx. and 303, *plates.*

Danube. **Voisin.**

Notice sur les Travaux d'amélioration de l'embouchure du Danube et du Bras de Soulina, 1857–1891. Par Voisin Bey. Paris, Dunod, 1893: 8vo, pp. 512. *Plates. Presented by Sir Charles Hartley, K.C.M.G.*

An account of the works carried out by the International Commission of the Danube for improving and maintaining the access for steamers to that river. The book, which is reprinted from the *Annales des Ponts et Chaussées* for January and February 1893, is based on the great official publications of the Commission, of which it forms a useful summary.

English Climatology. **Bayard.**

English Climatology 1881–1890. By Francis Campbell Bayard. [From the Quarterly Journal of the Royal Meteorological Society, Vol. xviii., No. 84, October, 1892.] 8vo, *map. Presented by the Author.*

Finland—Snowfall. *Fennia* (1892): **7** No. 3, pp. 60. **Sundell.**

Snötäckets höjd i Finland, Januari-Maj 1891. Af A. F. Sundell.

On the snowfall of Finland in the winter of 1891, with a map and French summary.

Flanders. *Ann. Géog.* **2** (1893): 306–314. **Gosselet.**

La plaine maritime du Nord de la France et de la Belgique, avec carte. Par Gosselet, professeur de géologie, Lille.

France. **Desjardins.**

Géographie, historique et administrative, de la Gaule Romaine. Par Ernest Desjardins, de l'Institut. Tome Quatrième. Les Sources de la Topographie comparée; contenant 13 planches et 17 figures dans le texte, suivi d'une table alphabétique générale de tout l'ouvrage. Paris, Hachette et Cie., 1893: pp. iv. and 296. *Price* 20 *fr.*

The last volume of the late M. Desjardins' great work on Roman Gaul was little more than commenced at the author's death, and a large amount of material which he had collected remained undiscussed. The volume now issued is in part written by M. Longnon, who, with other friends and pupils, has revised the whole, and the complete index to the four volumes was compiled by Mme. Desjardins. The volume deals with the Roman roads of France, but from the circumstances mentioned above the description is incomplete. M. Longnon therefore hopes in an independent work on which he is now engaged to produce what will be really the final volume according to his master's original plan.

France—The Causses. *Bul. Soc. normande Géog.* **14** (1892): 266–288, 320–335. **Martel.**

Le sous-sol des Causses (Cavernes et rivières souterraines). Par M. E. A. Martel. *Numerous illustrations.*

French Lakes. *Compt. Rend.* **116** (1893): 700–702. **Delebecque.**

Sur les lacs des Sept-Laux (Isère) et de la Girotte (Savoie). Note de M. A. Delebecque.

Germany—Oder. **Leonhard.**

Der Stromlauf der mittleren Oder. Inaugural-Dissertation zur Erlangung der philosophischen Doctorwürde . . . Universität Breslau. April, 1893. 8vo, pp. 72. *With maps. Presented by the Author.*

An account of changes in the course of the River Oder, with maps of its position at different dates.

Italy. **Baedeker.**

Italy. Handbook for Travellers. By K. Baedeker. Second Part: Central Italy and Rome. Eleventh edition. Leipsic, Karl Baedeker, London, Dulau & Co., 1893: pp. lxxii. and 420, *maps, plans, etc. Price* 6 *marks. Presented by Messrs. Dulau & Co.*

Montenegro. *Rev. Française* **17** (1893) : 337–354. **Sobieski.**

Le Monténégro. Étude géographique et militaire. Par Sobieski.

A summary of the geography of Montenegro with an outline map.

Russia. *Bul. Soc. Roy. Géog. Anvers* **17** (1893): 184–206. **Gourévitch.**

Les ressources matérielles et intellectuelles de la Russie. Par M. Gourévitch.

Amongst other changes in progress in modern Russia the displacement of the great industrial centres from north to south, and the growing importance of the Black Sea harbours, are referred to.

Scandinavia. *Ausland* **66** (1893) : 170–172, 186–188. **Haas.**

Vorweltliche Lateritbildung in Skandinavien und ihre Beziehungen zum Tertiär und Diluvium Norddeutschlands. Von H. J. Haas (Kiel).

Spain—Teruel. *Ann. Géog.* **2** (1893) : 315–328. **Dereims.**

Nouvelles Observations sur la Géographie physique du Plateau de Teruel, avec figures et une carte en couleur. Par A. Dereims, Paris.

The cretaceous plateau of Teruel, south of the Ebro, is one of the poorest and most barren parts of Spain, effects which the author traces to the character of the soil, the altitude, and the extreme severity of the climate.

Spain. *Verhandl. Ges. Erdkunde Berlin* **20** (1893) : 131–147. **Fischer.**

Herr Professor Theobald Fischer : Reiseskizzen aus Spanien und Portugal. *With map.*

An abstract of this paper appears at p. 347.

Sussex. **Murray.**

Handbook for Travellers in Sussex. Fifth edition. London, John Murray, 1893 : post 8vo, pp. [22] and 173, *maps and plan*. *Price* 6*s*. *Presented by Mr. Murray.*

The numerous large-scale maps, by Bartholomew, form a special feature of this edition.

Switzerland—Maps. **Graf.**

Bibliographie Nationale Suisse. Cartes de Parcelles plus ou moins grandes du territoire Suisse. Publié par le Bureau Topographique Fédéral. Rédigé par le Prof. Dr. J. H. Graf. (Fascicule II *b*.) Berne, K. J. Wyss, 1892 : pp. 171–335.

Turkey—Chalkidike. *Mitt. Geog. Ges. Wien* **36** (1893) : 1–22. **Brüch.**

Des Aristoteles Heimat oder die Halbinsel Chalcidice. Von Josef Adolf Brüch.

ASIA.

Borneo—Sambas. *Bul. Soc. Géog. Lyon* **11** (1893) : 543–563. **Agassis.**

Un Voyage à Bornéo, Sambas (Ouest Bornéo). Par M. F. Agassis.

Ceylon—Census. **Lee.**

Census of Ceylon, 1891. . . . Compiled by Lionel Lee. 3 vols. Colombo, 1892 : folio, pp. (Vol. i.) vii. and 63, *map*; (Vol. ii.) iv. and 547; (Vol. iii.) 95.

The population of Ceylon consisted on February 26th, 1891, of 3,007,789 persons.

Cyprus. *Zeitsch. Ges. Erdkunde Berlin* **27** (1892): 420–486. **Oberhummer.**

Aus Cypern. Tagebuchblätter und Studien. Von Eugen Oberhummer. II. Teil.

India. **Deakin.**

Irrigated India. An Australian view of India and Ceylon, their Irrigation and Agriculture. By the Hon. Alfred Deakin, M.L.A. With a map. London, Thacker & Co., 1893: 8vo, pp. xii. and 322. *Presented by the Secretary of State for India.*

India—Great Trigonometrical Survey. ——

Synopsis of the Results of the Operations of the Great Trigonometrical Survey of India. Vol. xxvii. Descriptions and Co-ordinates of the Principal and Secondary Stations and other fixed points of the Madras Longitudinal Series or Series G of the Southern Trigon. Prepared in the Office of the Trigonometrical Branch, Survey of India, Colonel G. Strahan, R.E., Deputy Surveyor-General, in Charge. Published under the orders of Colonel H. R. Thuillier, R.E., Surveyor-General of India. Dehra Dun, 1892: 4to, pp. 149, *diagram and charts.*

—— Vol. xxviii. The Madras Meridional and Coast Series or Series E of the Southern Trigon. Dehra Dun, 1892: 4to, pp 185, *diagram and charts.*

—— Vol. xxx. The Abu Meridional Series or Series I and the Gujarat Longitudinal Series or Series K of the South-West Quadrilateral. Dehra Dun, 1892: 4to, pp. 18, and 60, *diagram and charts. Presented by the Secretary of State for India.*

India—Historical. **Danvers.**

Report to the Secretary of State for India in Council on the Portuguese Records relating to the East Indies contained in the Archivo da Torre do Tombo, and the Public Libraries at Lisbon and Evora. By F. C. Danvers. London, 1892: 8vo, pp. xii. and 210. *Presented by the Secretary of State for India.*

India—Karnal District. ——

Gazetteer of the Karnal District. Compiled and published under the authority of the Punjab Government. Lahore, 1892: pp. ix., 322, and xliii. *Presented by the Secretary of State for India.*

Japan—Yezo. *Smithsonian Report* (1890): 417–502. **Hitchcock.**

The Ancient Pit-dwellers of Yezo, Japan. . . . The Ainos of Yezo, Japan. By Romyn Hitchcock. *Many illustrations.*

Northern Siberia. **Cherski.**

Wissenschaftliche Resultate der von der kaiserlichen Akademie der Wissenschaften zur Erforschung des Janalandes und der Neusibirischen Inseln in den Jahren 1885 und 1886 ausgesandten Expedition. Abtheilung IV. Beschreibung der Sammlung post-tertiärer Säugethiere. Von J. D. Tscherski. St. Petersburg, 1892: roy. 4to, pp. 512. *Plates.*

This paper forms No. 1 of Volume xl. of the *Memoirs* of the St. Petersburg Academy of Sciences.

Palestine. **Merrill.**

The Jaffa and Jerusalem Railway. By Selah Merrill. Large 8vo, pp. 11, *illustrations. From 'Scribner's Magazine,' March,* 1893.

Pamirs. *Ausland* **66** (1893): 193–197, 212–214, 230–234, 246–250. **Stern.**

Pamir "das Dach der Welt." Von Bernhard Stern (Wien).

Replete with references to papers in all languages.

Perak Handbook. ——

The Perak Handbook and Civil Service List, 1893. With a new map. Taiping: large 8vo, pp. xxviii. and 301. *Presented by the Government Printer, Perak.*

Philippine Islands. *Journ. Soc. Arts* **41** (1893): 577–590. **MacPherson.**

The Philippine Islands. By H. A. MacPherson. With discussion.

Siberia. ——

Die wissenschaftliche Thätigkeit der Ost-Sibirischen Sektion der kaiserlichen russischen geographischen Gesellschaft im Jahre 1891: 8vo, pp. 40.

Siberia—Orkhon. *Bul. Acad. Imp. Sci. St. Petersburg* **35** (1893): 353–398. **Radloff.**

Dr. W. Radloff's Vorläufiger Bericht über die Resultate der mit Allerhöchster Genehmigung von der Kaiserl. Akademie der Wissenschaften ausgerüsteten Expedition zur archäologischen Erforschung des Orchon-Beckens. Aus dem Russischen übersetzt von O. Haller.

Sumatra Achin. *Globus* **63** (1893): 281–288. **Schott.**

Ein Besuch in Atjeh auf Sumatra. Von Dr. Gerhard Schott, Berlin. *Illustrations.*

General account of a short visit to Achin in 1892.

Tibet. **Bower.**

Diary of a Journey across Tibet. By Captain H. Bower, 17th B.C. Calcutta (not for sale), 1893: 8vo, pp. 116 and x., *maps and illustrations.*

The illustrations are reproduced admirably from photographs, and the diary records all the incidents of Captain Bower's well-known journey.

AFRICA.

Africa. **Waller.**

Health Hints for Central Africa, with remarks on "Fever," its Treatment and Precautions to be used in Dangerous Localities. By Rev. Horace Waller. Fifth edition. London, John Murray, 1893: 16mo, pp. 62. *Price* 1s. *Presented by the Author.*

African Flora. *Natural Science* **2** (1893): . **Elliot.**

Climate and Floral Regions in Africa. By G. F. Scott Elliot, M.A., B.SC.

Cameroons. **Jaeger.**

Kamerun und Sudan. Ein Mahnwort an das deutsche Volk. Von H. Jaeger. Erster Teil. Berlin, Benge, 1892: 8vo, pp. 162. *Presented by the Publisher.*

The author, alarmed by French and British indifference to the claims of Germany to the hinterland of the Cameroons, has prepared this work as a reminder to his countrymen that they should develop the resources of West Africa.

Cape of Good Hope. **Campbell.**

Imperial Federation Series of Colonial State-Paper Catalogues. Edited by Frank Campbell (of the Library, British Museum). No. 1. Cape of Good Hope, 1892 (Preliminary Issue). London, 1893: 8vo, pp. 20. *Price* 6*d.* *Presented by the Editor.*

If well carried out on a uniform plan the scheme for an index of Colonial State Papers foreshadowed in this pamphlet should prove useful.

East Africa. **Davis.**

An American in Africa. By Richard Harding Davis. 8vo, pp. 3, *portrait.* *From 'Harper's Magazine,' March*, 1893.

A brief sketch of Mr. William Astor Chanler's Expedition in Africa.

East Africa. **Sheldon.**

Sultan to Sultan. Adventures among the Masai and other Tribes of East Africa. By M. French Sheldon, "Bébé Bwana." London, Saxon & Co., 1892: sm. 4to, pp. 435, *map, portrait, and illustrations.*

A narrative of experiences in the Kilimanjaro Region of East Africa.

Egypt—Nile. *Mitt. Geog. Ges. Wien* **36** (1893): 165–186. **Kupka.**
Nil-Gezeiten und Bewässerung. Von P. F. Kupka.

Exploration. **Veth.**
De Nederlanders in Afrika. Door P. J. Veth. Leiden, E. J. Brill, 1893: 8vo, pp. 56. *Presented by the Author.*

On the work of the Dutch in exploring Africa.

Kilimanjaro. **Le Roy.**
Missions Catholiques (1893): 10, 16, 29, 54, 64, 76, 90, 101, 113, 124, 137, 149, 161, 173, 187, 197, 209, *illustrations.*
Au Kilima-Ndjaro (Afrique Orientale). Par Mgr. Alexandre Le Roy. Deuxième Partie. Du Kilima-Ndjaro au Zanzibar.

Mashonaland. ———
Mashonaland: 8vo, pp. 37. *From the 'Edinburgh Review,' April*, 1893.

Sierra Leone. **Sibthorpe.**
The Geography of Sierra Leone. Revised, corrected and enlarged. By A. B. C. Sibthorpe, *alias* Aucandu, Prince of Cucuruku, Niger, F.P. Second edition. London, Elliot Stock: 16mo, pp. 24.
The Geography of the Surrounding Territories of Sierra Leone. Same author and publisher. 16mo, pp iv. and 46. *Presented by the Author.*

These little books are arranged in the form of question and answer, and intended for use in schools. While much of the information is trustworthy and a good deal of it fresh and interesting there are many statements which require to be qualified.

Slave Trade. **Stanley.**
Slavery and the Slave Trade in Africa. By Henry M. Stanley. 8vo, pp. 19, *illustrations. From 'Harper's Magazine,' March*, 1893.

Tuat. *Globus* **63** (1893): 274–277. **Rohlfs.**
Tuat, von Gerhard Rohlfs.

West Central Africa. **Arnot.**
Bihé and Garenganze. Or Four Years' Further Work and Travel in Central Africa. By Fred. S. Arnot. London, Hawkins & Co. [1893]: 8vo, pp. viii. and 150. *Price* 2*s.* 6*d. Presented by the Author.*

The record of a very remarkable journey from Benguella through Bihé to Garenganze (Katanga), returning by the Sankuru and Congo. The description is mainly from the missionary point of view.

NORTH AMERICA.

Alaska. *National Geog. Mag.* **4** (1893): 177–197. **Mendenhall** and others.
The Alaskan Boundary Survey. I. Introductory. By Dr. T. C. Mendenhall. II. The Boundary South of Fort Yukon. By J. E. McGrath. III. The Boundary North of Fort Yukon. By J. Henry Turner.

Alaska—Weniaminof. *Trans. Geog. Soc. Pacific* **3** (1892): 59–62. **Davidson.**
The Eruption of the Volcano Weniaminof Peninsula of Alaska. By George Davidson. *With map.*

The eruption took place in August, 1892, and the volcano occurs in a region as yet almost unexplored.

America. *Mitt. Geog. Ges. Wien* **36** (1893): 85–99. **Marilaun.**
Der Antheil Oesterreichs an der naturwissenschaftlichen Erforschung Amerikas. Von A. Kerner von Marilaun.

British Columbia. *Journ. Roy. Colonial Inst.* **25** (1893): 327–352. **Dawson.**
The Mineral Wealth of British Columbia. By George M. Dawson, C.M.G., LL.D.

Canada. **Nelson.**

The North-West of Canada. By Joseph Nelson. Large 8vo, pp. 5. *From the 'Westminster Review,' March*, 1893.

Historical Geography. *Rev. Géog.* **32** (1893): 242–248. **Marcel.**

La Colonisation française dans l'Amérique du Nord. d'après l'Exposition Cartographique de la Bibliothèque Nationale, organisée par M. Gabriel Marcel. A-propos de l'Exposition universelle de Chicago (1893).

Mexico. *American Journ. Sci.* **45** (1893): 307–324. **Hill.**

The Cretaceous Formations of Mexico and their Relations to North American Geographic Development. By Robert T. Hill.

A discussion of the geology of Mexico, with sketch maps and other diagrams.

United States. **Baedeker.**

The United States with an Excursion into Mexico. Handbook for Travellers, edited by Karl Baedeker. With 17 maps and 22 plans. Leipsic, Karl Baedeker; London, Dulau & Co., 1893: 12mo. pp. c. and 516. *Price* 12*s*. *Presented by Messrs. Dulau & Co.*

Many excursionists in the United States this year will thank Mr. J. F. Muirhead for the admirable guide-book he has added to Baedeker's Series. The subject is perhaps the most difficult ever attempted, but the familiar minuteness of essential detail, clear arrangement and practical character were never more usefully brought together.

United States—Athabascan Languages. **Pilling.**

Bibliography of the Athapascan Languages. By James Constantine Pilling. Washington, Government Printing Office, 1892: 8vo, pp. 126.

United States—California. *Verhandl. Ges. Erdkunde, Berlin* **20** (1893): 116–130. **Hilgard.**

Herr Professor Dr. E. W. Hilgard: Skizze der physikalischen und industriellen Geographie Californiens. *With map.*

United States—Dakota Dictionary. **Riggs.**

Department of the Interior, United States Geographical and Geological Survey of the Rocky Mountain Region, J. W. Powell in charge. Contributions to North American Ethnology. Vol. vii. A Dakota-English Dictionary. By Stephen Return Riggs, edited by James Owen Dorsey. Washington, 1890: 4to, pp. x. and 665. *Presented by the Director of the Survey.*

United States—Indian Ethnology. **Powell.**

Seventh Annual Report of the Bureau of Ethnology to the Secretary of the Smithsonian Institution, 1885–86. By J. W. Powell, Director. Washington, 1891: 4to, pp. xli. and 409, *maps and plates. Presented by the Director of the Bureau of Ethnology.*

United States—Mount Whitney. *Sierra Club Bulletin* **1** (1893): 1–8. **Dyer**

The Mount Whitney Trail. By Hubert Dyer.

The first number of the *Bulletin of the Sierra Club* of San Francisco contains several other short articles on local geography and mountaineering.

United States—Tacoma. **Wickersham.**

Is it "Mount Tacoma" or "Rainier"? What do History and Tradition say? By Hon. James Wickersham. *From the Proceedings of the Tacoma Academy of Science*, 1893: 12mo, pp. 16. *Presented by the Author.*

Vin'and. *Bull. American Geog. Soc.* **24** (1892): 510–535. **Smith.**

The Vinland Voyages. By Professor Charles Sprague Smith.

Professor Smith reviews the evidence for the historical accuracy of the Sagas, and concludes, "We therefore affirm unhesitatingly that, about the year 1000, some portions of the Eastern American coast were discovered by Norsemen, and an attempt was made to colonise them." He does not enter into any discussion as to the landfall, or the modern names of Markland, Vinland, and Helluland.

CENTRAL AND SOUTH AMERICA.

Paraguay. **Bruyssel.**

La République du Paraguay. Par Ernest Van Bruyssel. Bruxelles, Libraire Européenne, C. Muquardt, 1893: 8vo, pp. 220. *Price 6 francs.*

A compilation from various sources brought together to form a picture of the history and present state of Paraguay similar to the author's previous works on Mexico, Uruguay, and the Argentine Republic.

Patagonia. **Hudson.**

Idle Days in Patagonia. By W. H. Hudson, C.M.Z.S. Illustrated by Alfred Hartley and J. Smit. London, Chapman & Hall, 1893: 8vo, pp. viii. and 256. *Price 14s.*

A charming narrative of wanderings in the extreme south of the Argentine Republic showing the same sympathetic insight into plant and animal life which characterise the author's earlier book on the Argentine Republic.

Patagonia. *Pet. Mitt.* **40** (1893): 49–62. **Siemiradzki.**

Eine Forschungsreise in Patagonien von Dr. Josef v. Siemiradzki.

West Indies—Tobago. *Geog. Blätt.* **16** (1892): 1–20. **Eggers.**

Die Insel Tobago von Baron H. Eggers.

The paper is accompanied by a vegetation-map of the island.

AUSTRALASIA AND PACIFIC ISLANDS.

Australia. **Saville-Kent.**

The Great Barrier Reef of Australia, its Products and Potentialities. By W. Saville-Kent, F.L.S., etc. Containing an account, with copious coloured and photographic illustrations (the latter here produced for the first time), of the corals and coral reefs, pearl and pearl-shell, bêche-de-mer, other fishing industries, and the marine fauna of the Australian Great Barrier region. London, W. H. Allen & Co. [1893]: 4to, pp. xxiii. and 387, *map*. *Price £4.*

This work will be specially reviewed.

Australia. *Journ. Roy. Colonial Inst.* **24** (1893): 225–262. **Wallace.**

Australasian Agriculture. By Professor Robert Wallace.

Australia—Vegetation. *Jour. and Proc. Roy. Soc. N.S.W.* **26** (1892): 178–239. **Hamilton.**

On the Effect which Settlement in Australia has produced upon Indigenous Vegetation. By Alex. G. Hamilton.

British New Guinea. ——

Annual Report on British New Guinea from July 1st, 1891, to June 30th, 1892, with appendices. Brisbane, J. C. Beal, 1893: folio, pp. xxxii. and 113, *maps*.

This Report, as usual, mainly consists of a collection of despatches from Sir William Macgregor, describing visits to various parts of the Possession, most of which have already been noticed in these pages.

New Guinea. *Journ. Roy. Colonial Inst.* **24** (1893): 419–444. **Richards.**

British New Guinea. By T. H. Hatton Richards.

New Hebrides. *Trans. Roy. Geog. Soc. Austral. (Victoria Branch)* **10** (1893): 32–40. **Lindt.**

The Resources and Capabilities of the New Hebrides. A Pioneer Coffee Plantation. By J. W. Lindt, F.R.G.S.

New Hebrides—Santo. *Trans. Roy. Geog. Soc. Austral. (Victoria Branch)* **10** (1893): 43–57. **Macdonald.**

West Coast of Santo—Traditions, Superstitions, Customs, etc. By the Rev. A. H. Macdonald.

New South Wales. ——

Annual Statement of Works carried out by Public Works Department during the year 1891. Sydney Charles Potter: fo, pp. 192. *Illustrations. Price 7s. 6d. Presented by the Agent-General for New South Wales.*

The descriptions of railway extension, harbour and water-works, and sewerage, are illustrated by a series of fine photographic reproductions, showing the manner in which the natural conditions of the surface have been dealt with by the Colonial engineers.

New Zealand—Tongariro. *Trans. Roy. Geog. Soc. Austral. (Victoria Branch)* **10** (1893): 15–25. **Cussen.**

Notes on the Tongariro-Ruapehu Volcanic Mountains, New Zealand. By Laurence Cussen, Esq.

Illustrated notes with rough sketch-maps from the Government surveys.

Queensland—Census. ——

Eighth Census of the Colony of Queensland, taken on April 5, 1891. Brisbane, J. C. Beal, 1892: folio, pp. lxxxiv., 469 and xci., *map and diagram.*

The total population of the Colony, exclusive of aborigines, enumerated on April 5th, 1891, was 393,718 persons—223,779 males and 169,939 females.

Samoa. ——

Weissbuch. Vorgelegt dem Reichstage in der 2 Session der 8 Legislatur-Periode, Dreizehnter Theil. Samoa iv. Berlin, Carl Heymanns Verlag, 1893: 4to, pp. 218.

Official correspondence regarding Samoa from April 1890 to December 1892.

South Australia. **Todd.**

Meteorological observations made at the Adelaide Observatory, and other places in South Australia and the northern territory, during the year 1890, under the direction of Charles Todd. Adelaide, 1892; folio, pp. 42 and 117, *maps.*

Victoria—Railway Guide. **Myers and Chambers.**

The Victorian Tourists' Railway Guide, edited by "Telemachus" (Francis Myers), written and compiled by Francis Myers and Trant Chambers. Melbourne, Fergusson & Mitchell, 1892: 8vo, pp. 159, *maps. Price* 1*s.*

This is an official publication, and contains a succinct description of the Victorian railway system from the date of its origin, to its latest developments. It also includes a brief history of the railways, with the nature of the accommodation, and the character of the country traversed by each separate line.

Western Australia. *Jour. Roy. Colonial Inst.* **24** (1892): 6–52. **Fraser.**

The Present Condition and Prospects of Western Australia. By Sir Malcolm Fraser, K.C.M.G.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

Geodesy. *Fennia* (1892): **7**, *No.* 1, *pp.* 196. **Bonsdorff.**

Mesures de bases de Moloskovitzi et de Poulkovo exécutées en 1888 avec l'appareil de Jäderin. Avec deux planches.

Geodesy. **Weiss and Schram.**

Astronomische Arbeiten des k.k. Gradmessungs-Bureau .... herausgegeben von Prof. Dr. Edmund Weiss und Dr. Robert Schram. IV. Band. Längenbestimmungen. Wien, F. Tempsky, 1892. Roy 4to, pp. 192.

Full discussion, by F. Kuhnert and A. Nahlik, of astronomical observations at Greenwich and Vienna, resulting in the time difference between the two observatories being fixed as 1 hr. 5 mins. 21·421 secs. ± 0·021 secs. The preliminary observations for Berlin are also given by E. Becker.

Oceanography. *Pet. Mitt.* **39** (1893): 85–88. **Krummel.**

Russische Arbeiten zur Ozeanographie des Nordpacifischen Ozeans. Von Prof. Dr. O. Krummel. *With map of salinity in colours.*

Oceanic Research. *Comptes Rendus* **116** (1893): 539–540. **Thoulet.**

Sur l'emploi de cartouches solubles, dans les mesures et expériences océanographiques. Par M. J. Thoulet.

A proposal to actuate mechanism at great depths, by weights or springs set in action by the solution of a bar (used as a "toggle") in a certain definite time.

Pacific Ocean. *Trans. Geog. Soc. Pacific* **3** (1892): 63–83. **Tanner.**

Cable Surveys. From California to the Hawaiian Islands, 1891–92. By Lieut.-Commander Z. L. Tanner, U.S. Navy.

Valleys. **Wallace.**

Inaccessible valleys; a study in physical geography. By Professor Alfred R. Wallace: 8vo, pp. 13. *From the 'Nineteenth Century,' March*, 1893.

Mainly descriptive of the Yosemite Valley in California, and the valleys of the Grose and Cox Rivers in New South Wales.

GENERAL.

America and Australasia. **Meath.**

A Britisher's impressions of America and Australasia. By the Right Hon. the Earl of Meath: 8vo, pp. 21. *From the 'Nineteenth Century,' March*, 1893.

Biography—Penck. *Deutsche Rundschau* **15** (1893): 372–375. **Umlauft.**

Albrecht Penck, von Friedrich Umlauft. *With Portrait.*

Cannibalism. *Deutsche Rundschau* **15** (1893): 348–397. **Henkenius.**

Entstehung und Verbreitung der Anthropophagie. Von H. Henkenius, Stabsarzt a. d. in Heidelberg. (Mit einer Karte.)

Columbus. **Abbate.**

Il Genio e l'obbiettivo di Colombo. In rapporto alle condizione geografiche contemporanee dell' Egitto. Memoria del Dr. Abbate Pascia, Presidente della Société Khédiviale de Géographie. Napoli, 1893, 8vo, pp. 32. *Presented by the Author.*

French Colonial Policy. ——

The Colonial Policy of France: 8vo, pp. 34. *From the 'Edinburgh Review,' April*, 1893.

Historical. **Martins and Boutrone.**

Les Explorations des Portugais antérieures à la Découverte de l'Amérique. Par M. J. P. de Oliveira Martins. Traduite de l'Espagnol par Alexandre Boutrone. Paris, Leroux, 1893: 8vo, pp. 34. *Map. Presented by M. A. Boutrone.*

Historical. *Smithsonian Report* (1890): 611–639. **Watkins.**

The Log of the *Savannah*. By J. Elfreth Watkins.

Authentic account, with illustrations, of the first voyage of a steam vessel across the Atlantic.

Historical Geography. **Abbate.**

Dr. Abbate Pacha—De la prétendu Sphéricité de la Terre connu des anciens Égyptiens. Le Caire, 1893: 8vo, pp. 16. *Presented by the Author.*

A denial of the common statement that the true form of the Earth was known to the early Egyptians; all references in the "Book of the Dead," referring only to a flat rectangular Earth.

Historical Geography. *Mitt. Geog. Ges. Wien* **36** (1893): 100–117. **Gelcich.**

Lösung der Martin-Behaim Frage. Von Eugen Gelcich.

Historical Geography. **Winsor.**

The anticipations of Cartier's voyages, 1492–1534. By Justin Winsor, Cambridge, U.S.A. John Wilson & Son, 1893: 8vo, pp. 14, facsimiles.

Historical Geography—Hanno. **Fischer.**

Untersuchungen auf dem Gebiet der alten Landes- und Volkeskunde. Von Curt. Th. Fischer. Erstes Heft. De Hannonis Carthaginiensis Periplo. Leipzig, Teubner, 1893: 8vo, pp. 134. *Price* 3 *marks. Presented by the Publisher.*

A Latin treatise on the 'Periplus' of Hanno.

Place Names. **Egli.**

Nomina Geographica. Sprach- und Sacherklärung von 42,000 geographischen Namen alle Erdräume. Von Dr. J. J. Egli. Zweite vermehrte und verbesserte Auflage. Leipzig, Brandsteller, 1893: 8vo, pp. viii. and 1036. *Price* 28 *marks.*

The first edition of this fascinating work was published twenty years ago, and the Author now gives the results of his further studies in geographical etymology by way of addition and correction.

Population of the Earth. **Wagner and Supan.**

Die Bevölkerung der Erde, IX. Herausgegeben von Hermann Wagner und Alexander Supan. Ergänzungsheft Nr. 107 zu *Petermann's Mitteilungen.* Gotha, Justus Perthes, 1893: 4to, pp. vi. and 130. *Price* 7 *m.*

This part contains comparative statistics of the censuses of 1890 or 1891 with those of the previous decade. A list of the largest towns of the Earth is given, in which 270 are enumerated as containing over 100,000 inhabitants; of these 35 contain over 500,000, twelve of them being over a million.

St. Paul and Amsterdam. *Ann. Geog.* **2** (1893): 329–354. **Velain.**

Les Iles Saint-Paul et Amsterdam (Océan Indien), avec figures et deux cartons par Ch. Velain, Paris.

NEW MAPS.

By J. COLES, *Map Curator*, R.G.S.

EUROPE.

Durham. **Bartholomew.**

Plan of Durham. Scale 1:15,330, or 4·8 inches to a geographical mile. Environs of Durham. Scale 1:255,000, or 3·5 geographical miles to an inch. W. H. Smith & Son's Series of Reduced Ordnance Maps for Tourists by J. Bartholomew, F.R.G.S. London. *Price* 1*s. Presented by Messrs. J. Bartholomew & Co.*

England and Wales. **Ordnance Survey.**

Publications issued since April 12th, 1893.

6-inch—County Maps:—

ENGLAND AND WALES: **Lancashire**, 1, 2*s.* 6*d.*; 3, 2*s.*; 4, 2*s.* 6*d.*; 9, 2*s.*; 10, 2*s.*; 13, 2*s.*; 15, 2*s.* 6*d.*; 23, 2*s.* 6*d.* **Yorkshire**, 170, 2*s.* 6*d.*; 86, N.W., 106, S.E., 110, N.W., N.E., 122, S.W., 123, N.E., 146, S.W., 163, N.W., 174, S.E., 193, N.E., 194, N.W., 289, N.W., 1*s.* each.

25-inch—Parish Maps:—

ENGLAND AND WALES: **Lancashire**, XLIV. 12, 5*s.*; 16, 4*s.*; XLV. 10, 12, 15, XLVI. 10, 14, LI. 3, LIII. 4, LXXIX. 1, 2, 4*s.* each; 3, 3*s.*; 5, 6, 4*s.* each; 7, 3*s.*; 10, 5*s.*; 11, 4*s.*; 16, 5*s.*, XCV. 5, 7, 8, 9, 10, 11, 12, 13, 5*s.* each; 14, 8*s.*; XCVI. 5, 5*s.*; 7, 11*s.* 6*d.*; 10, 5*s.*; 15, 11*s.* 6*d.*; XCIX. 12, 15, 5*s.* each; CIII. 8, 11*s.* 6*d.*; CIV. 3, 14*s.*; 4, 11*s.* 6*d.*; 8, 8*s.*; 12, 14*s.*; 13, 5*s.*; CVII. 1, 6, 4*s.* each; CVIII. 9, 5*s.*; 10, 11, 12, 14, 15, CIX. 1, 4*s.* each; 2, 5, 6, 5*s.* each. **Yorkshire**, LIII. 1, 2, 3, 4, 6, 4*s.* each; 7, 3*s.*; 8, 4*s.*; 10, 3*s.*; 11, 14, 15, 16, LXVII. 3, 4, 5, 6, 7, 8, 9, 4*s.* each; 10, 5*s.*; 11, 13, 4*s.* each; 14, 5*s.*; 16, 3*s.*; LXVIII. 1, 2, 3, 4, 4*s.* each; 5, 6, 5*s.* each; 7, 8, 9, 10, 11, 12, 13, 14, 4*s.* each; 15, 5*s.*; 16, LXXIII. 1, 5, 4*s.* each; 6, 3*s.*; 13, LXXXIX. 2, 5, 4*s.* each; 9, 3*s.*; 12, CXL. 1, CLVIII.

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Nottingham. **Bartholomew.**

Plan of Nottingham. Scale 300 yards to an inch. W. H. Smith & Son's Series of Reduced Ordnance Maps for Tourists, by J. Bartholomew, F.R.G.S. London. *Price* 1*s. Presented by Messrs. J. Bartholomew & Co.*

This is a reduction from the Ordnance survey, and has been specially prepared with a view to the meeting of the British Association at Nottingham during the present year. It is drawn in a very clear style, and is well suited to the special purpose for which it has been published.

Switzerland. **Swiss Federal Staff.**

Topographischer Atlas der Schweiz im Massstab der Original-Aufnahmen nach dem Bundesgesetze vom 18 Dezember, 1868, durch das eidg. topogr. Bureau gemäss den Direktionen von Oberst Siegfried veröffentlicht. Scales 1 : 25,000, or 2·9 inches to a geographical mile, and 1 : 50,000, or 1·4 inches to a geographical mile. XL. *Lieferung:* Sheets Nos. 259, Euthal; 261, Iberg; 292, Orbe; 305, Sottens; 372, Schüpfheim; 374, Escholzmatt; 377, Stans; 380, Buochs; 459, Dent de Brenleire; 461, Château d'Oex; 476, Bex; 543. Melide. XLI. *Lieferung:* Nos. 246 bis, Schübelbach; 293, Yverdon; 295, Chavornay; 297, Le Lieu; 301, La Sarraz; 355 bis, Stockhorn; 373, Entlebuch; 375, Schimberg; 446, Coppet; 457, Dent de Lys; 487, Vissoye; 496, Visp. *Prices: fr.* 1 *and fr.* 1·25 *per sheet. Presented by the Topographical Bureau, Swiss Federal Staff.*

Switzerland. **Swiss Federal Staff.**

Zweisimmen-Gemmi. Scale 1 : 50,000, or 1·4 inches to a geographical mile. Topographical Bureau of the Swiss Federal Staff. Bern, 1892. *Price fr.* 5.

This is one of the series of maps now being issued by the Topographical Bureau of the Swiss Federal Staff, specially coloured to show the relief. It consists of sheets of the Siegfried Atlas of Switzerland, upon which the hill-work has been shaded in a most artistic manner.

Turkey. **"Les Missions Catholiques."**

Carte Ecclésiastique de l'Empire Ottoman d'après les "Missiones Catholicæ," 1893. Scale 1 : 3,500,000, or 47·6 miles to an inch. Supplément du *Journal des Missions Catholiques*. Paris : dessiné et gravé par R. Hausermann.

On this map are shown the extent and locations of the different Catholic Missions in the Ottoman Empire. In addition to this, the political divisions of the country, the roads, and railways are laid down, and at the foot of the map a large amount of information with regard to the Catholic missions is given in statistical form. An inset plan of Constantinople and its environs on an enlarged scale is given, and as the map is nicely drawn, and has evidently been compiled with care, it will be useful for general reference.

Tyrol. **Löwl.**

Karte der Intrusiven Kerne der Rieser Ferner. Von Prof. Dr. Ferdinand Löwl. Scale 1 : 100,000, or 1·3 geographical miles to an inch. With insets "Der Campellio Bruch," and "Der Granitbogen von Süd-Tirol." *Petermann's Geographische Mitteilungen*. Jahrgang 1893. Taf. 6. Gotha : Justus Perthes. *Presented by the Publisher.*

Vienna. **Freytag.**

Wand-Plan der Reichshaupt und Residenzstadt Wien, von Gustav Freytag, für Volks-Bürger und Mittelschulen bearbeitet, von Professor Dr. Friedrich Umlauft. Scale 1 : 10,000, or 7·3 inches to a geographical mile. Approbiert mit Erlass des h. k. k. Landesschulrathes Zahl 4159, vom 30 Mai, 1892. Verlag und Druck von G. Freytag und Berndt in Wien. 6 sheets. *Presented by the Publishers.*

This is a school wall-map of Vienna. It is printed in colour, and is drawn in a bold style, well suited to the purpose for which it is published. Full explanation is given with regard to the colouring and symbols employed; it also contains an inset, on an enlarged scale, of No. 1 Division of the city, and another, on a reduced scale, of Vienna inside the fortifications, showing the divisions of 1851.

ASIA.

Indo-China. **Pavie.**

Carte de l'Indo-Chine dressée sous les auspices du Ministre des Affaires Étrangères et du Sous-Secrétaire d'État des Colonies, par MM. les Capitaines Coupet, Friquegnon et de Malglaive, Membres de la Mission Pavie. Scale 1 : 1,000,000, or 13·6 geographical miles to an inch. 4 sheets.

This is a very important map, and contains a great deal of new work. It has been compiled by Captains Coupet, Friquegnon, and De Malglaive, members of the Pavie Mission, from the most recent and reliable sources. The map includes Tongking, parts of Burmah and Southern China, Siam, Anam, Cambodia, and Cochin China. It is printed in colours; the hill-work in brown, water blue, the routes in red. Wherever the rivers or routes have been reconnoitered they are distinguished from those which have not by the manner in which they are shown. The settled boundaries are indicated by red crosses. The size and importance of each town is shown by the symbol employed to indicate its position. At the foot of the map a useful table is given, containing the abbreviations and translation of the principal geographical terms that appear on the map. The scale is sufficiently large to admit of a considerable amount of detail being shown, and taken as a whole, the manner in which the map has been produced is very effective.

AMERICA.

California. **Gesellschaft für Erdkunde zu Berlin.**

Physikalische Skizze von Californien. Scale 1 : 4,000,000, or 55·5 geographical miles to an inch. Gesellschaft für Erdkunde zu Berlin. Sitzung vom 4 Februar, 1893. *Presented by the Geographical Society of Berlin.*

GENERAL.

The World. **Kiepert.**

Kiepert's Grosser Hand-Atlas. Neue Lieferungs-Ausgabe in 45 Karten. Ausgabe in 9 Lieferungen à 5 Karten mit statistischem Material und Namen-Verzeichniss mit Bevölkerungsziffern zu jeder Karte. Die statistischem Angaben von Dr. Paul Lippert, Bibliothekar des Kgl. Preuss. Statist. Bureaus. Dritte, in Zeichen—Institut der Verlagshandlung unter Leitung von Dr. R. Kiepert. Teils vollständig neu bearbeitete. Teils gründlich berichtigte Auflage. Berlin, 1893. Geographische Verlagshandlung Dietrich Reimer. Inhaber: Hoefer & Vohsen. Part II. *Price 4 M. each part. Presented by the Publishers.*

The second part of this atlas contains maps No. 7, The Rhine Provinces, Westphalia and Hessen-Nassau; No. 20, France (general); No. 21, Eastern France; No. 26, Scandinavia; and No. 38, The Nile Valley, and Western Arabia. The maps are very clearly drawn, the elevations of the land and the depths of the sea are given in metres. Each map is accompanied by an index and statistical letterpress.

The World. **Mayer & Luksch.**

Weltkarte zum Studium der Entdeckungen mit dem Colonialen Besitze der Gegenwart. Entworfen und bearbeitet von Ernst Mayer und Josef Luksch, Professoren a. d. k. u. k. Marine-Akademie in Fiume, 1893. Equatorial scale 1 : 20,000,000, or 274 geographical miles to an inch. Verlag von Artaria & Co. in Wien. 6 sheets. *Price 6 fl. Presented by the Publishers.*

This is a useful map for the purpose for which it is published. It is, however, hardly to be expected that it can give more than a very general idea of the exploration of the world. A table is given containing, in chronological order, the names of explorers by land and sea, together with a short note on the exploration. There is also a list of European colonial possessions in all parts of the world. The Spanish and Portuguese colonies in the sixteenth century are shown on a small inset map.

CHARTS.

Admiralty Charts. **Hydrographic Department, Admiralty.**

Charts and Plans published by the Hydrographic Department, Admiralty. March and April, 1893. *Presented by the Hydrographic Department, Admiralty.*

No.			Inches.	
1934	m	=	10·0	England, east coast:—River Tyne entrance. 2*s.* 6*d.*
117	m	=	0·39	North Atlantic Ocean:—Færoe Islands. 2*s.* 6*d.*
1776	m	=	7·4	Færoe Islands:—Trangjisvaag. 1*s.* 6*d.*
1871	m	=	4·0	Greece, Gulf of Volo:—Ports Surbi and Mijella. 1*s.* 6*d.*
1690	m	=	1·0	Newfoundland, west coast:—Hawke Bay to Sta. Genviéve Bay. 2*s.* 6*d.*
2812	m	=	7·5	Africa, west coast, Bight of Benin:—Lagos Harbour. 2*s.*
1747	m	=	4·0	Africa, east coast:—Lamu Harbour, Ozi Anchorage. 2*s.* 6*d.*
	m	=	1·0	
1779	m	=	4·0	India, west coast:—Veraval Roads, Jáfarábád Harbour. 1*s.* 6*d.*
	m	=	5·0	
2023	m	=	12·0	China Sea:—Singapore. New Harbour. 2*s.* 6*d.*
1781	m	=	3·0	Borneo, east coast:—Dent Haven. 1*s.* 6*d.*
2193	m	=	various	Eastern Archipelago:—Sketch Plans of anchorages between Mindanao and Celebes, North Bay. Lirung Road. Seree Bay. Beo Bay. Kulur Anchorage. Tabukan Road. Samboard Bay. Petta Anchorage. Miula Anchorage. Kampong Ulu Anchorage. Channel between Tagulanda and Ruang. 1*s.* 6*d.*
1057	m	=	1·0	Australia, north coast:—Entrance to Liverpool River. (Republished.) 1*s.* 6*d.*
880	m	=	1·5	Solomon Islands:—Marau Sound, Danae Bay. 1*s.* 6*d.*
187	—	—	—	Sicily:—Plan added, Port Licata.
1853	—	—	—	Callao:—Plan added, S. Lorenzo Island Anchorage.
1109	—	—	—	Red Sea:—Plan added, Mersa Sheikh Barud.

No.	Inches.	
962	— — —	Philippine Islands :—New plan. Port Kataingan.
1079	— — —	Tasmania :—Plan added, Emu Bay.
1264	— — —	Islands and anchorages in South Pacific :—New plans, Aitutaki. Arutunga Anchorage. Rarotonga.

(*J. D. Potter, Agent.*)

CHARTS CANCELLED.

No.		Cancelled by—		No.
1934	Entrance to the River Tyne	New plan.	River Tyne entrance	1934
117	Færoe Islands	New chart.	Færoe Islands ..	117
2812	Lagos River	New plan.	Lagos harbour ..	2812
2738	Plan of Veráwal Roads on this chart ..	New plan.	Veraval Roads on ..	1779
2023	Singapore New Harbour	New plan.	Singapore New Harbour	2023
1057	Liverpool River entrance	Republished plan.	Entrance to Liverpool River	1057
880	Marau Sound	New plan.	Marau Sound	880
2899	St. Andrew Bay.			
953	Omai-saki to the Gulf of Yedo. (Temporarily.)			

CHARTS THAT HAVE RECEIVED IMPORTANT CORRECTIONS :

A. to P. Index Charts, 16 sheets. No. 2045, England, south coast :—Owers to Christchurch. 2040, England, south coast :—The Solent. 1404, Scotland, west coast :—Ardrossan Harbour. 1610, England, east coast :—North Foreland to Orfordness. 46, Ireland, north coast :—Larne to Bloody Foreland. 2277 White Sea :—Sharapov Head to Ludoshnoi Point. 1657, Grecian Archipelago :—Gulf of Athens and entrance to Petali Gulf. 2531, North America, west coast :—Cape Mendocina to Vancouver Island. 793, b, Malacca Strait :—Pulo Penang to Parcelar Hill. 2578, Eastern Archipelago :—Sulu or Mindora Sea. 943, Eastern Archipelago :—Philippine Islands and adjacent seas, from Molucca Passage to Manila. 2577, Philippine Islands :—Between St. Bernardino and Mindoro Straits, with adjacent islands. 437, Australia, north coast :—Albany Pass to Booby Island. 2423, Papua or New Guinea :—Boigu Island to Cape Blackwood. 2120, Papua or New Guinea :—Cape Blackwood to Freshwater Bay. 1380, South Pacific Ocean :—New Caledonian, New Hebrides, and Loyalty Islands. 766, South Pacific Ocean :—Ellice Islands. (*J. D. Potter, Agent.*)

North Atlantic. **U.S. Hydrographic Office.**

Pilot Charts of the North Atlantic Ocean, for March, April, and May, 1893. Wreck Chart of the North Atlantic Coast of America. Published by the Hydrographic Office, Bureau of Navigation, Navy Department, Washington, D.C., 1893. Richardson Clover, Lieutenant-Commander, U.S.N. Hydrographer. *Presented by the U.S. Hydrographic Office.*

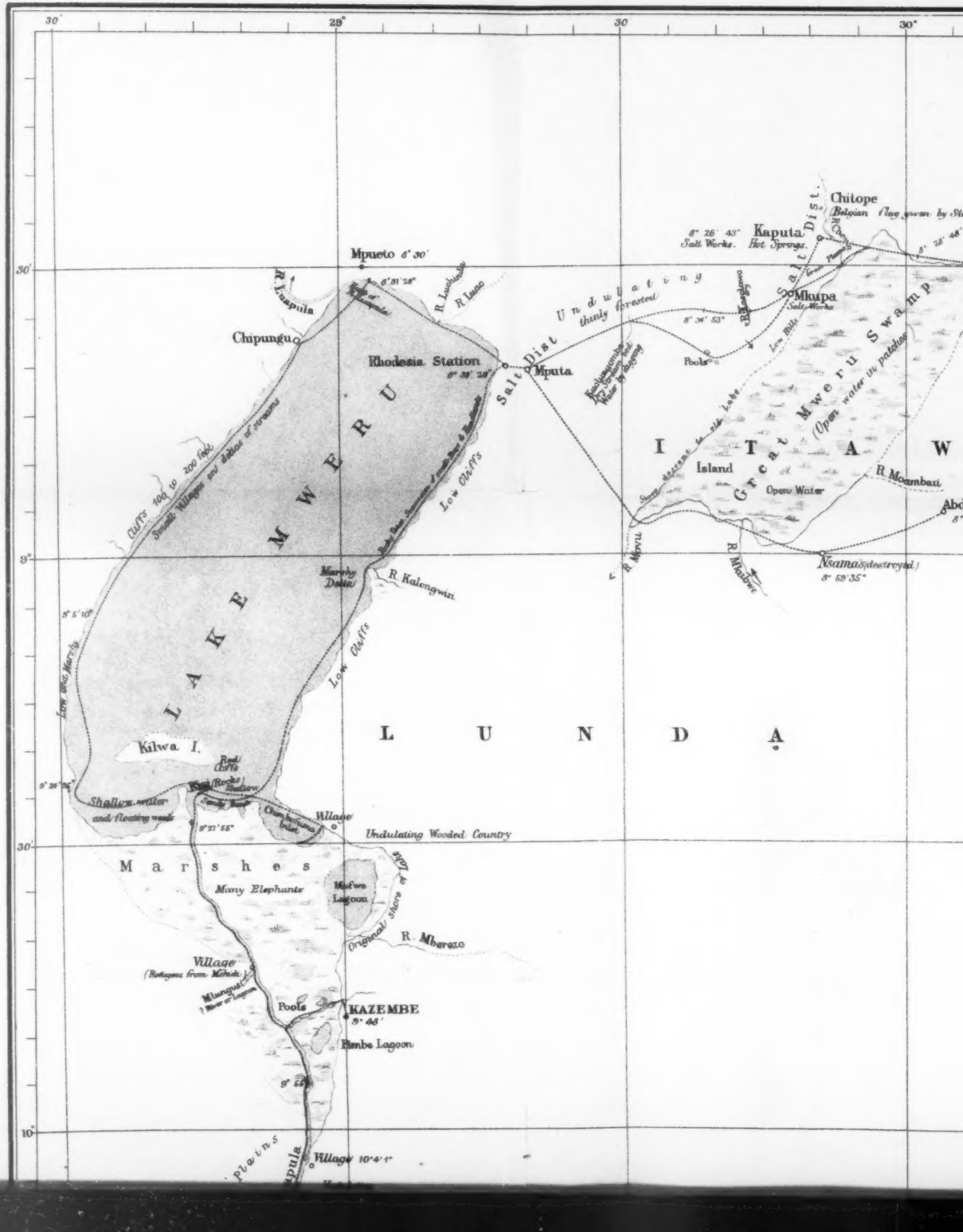
PHOTOGRAPHS.

Central America. **Maudslay and Bernoulli.**

Ten Photographs of Ancient Carving in Stone and Wood excavated by A. P. Maudslay, Esq., and Dr. Bernoulli in Central America, in the neighbourhood of the Usumacinta River. *Presented by Francis Parry, Esq.*

Nine of these photographs have been taken from ancient carvings in stone, brought to England by Mr. A. P. Maudslay, and which are at present in the South Kensington Museum. There is also a photograph of a wooden carving, from Tikal, Yucatan, the original of which was excavated by Dr. Bernoulli in 1879.

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.


30°
28°
30°
30°
Mpueto 8° 30'
R. Luapula
R. Luchemgwe
R. Luao
Chipungu
Rhodesia Station
8° 39' 28"
Salt Dist. Undulating thinly forested
Mputa
Kaputa
8° 26' 43"
Salt Works.
Hot Springs.
Chitope
Belgian flag flown by Sta
Mkupa
Salt Works
8° 34' 53"
Pools
Low Hills
Great Mweru Swamp
(Open water in patches)
I T A W
Island
Open Water
R. Mpamba
R. Mpweu
R. Mambwe
Nsama (destroyed)
8° 58' 35"
Cliffs 100 to 200 feet
Small Villages and deltas of streams
Low Cliffs
Marshy Delta
R. Kalongwisi
LAKE MWERU
Low Cliffs
L U N D A
Kilwa I.
Shallow water and floating weed
Village
8° 21' 55"
Undulating Wooded Country
M a r s h e s
Many Elephants
Mofwe Lagoon
Original Shore
R. Mbereze
Village
(Refugees from Mbereshi)
Mlungusi
Pools
KAZEMBE
9° 48'
Bimbe Lagoon
9° 55'
Village 10° 4' 1"
10°
30'
9°
30'

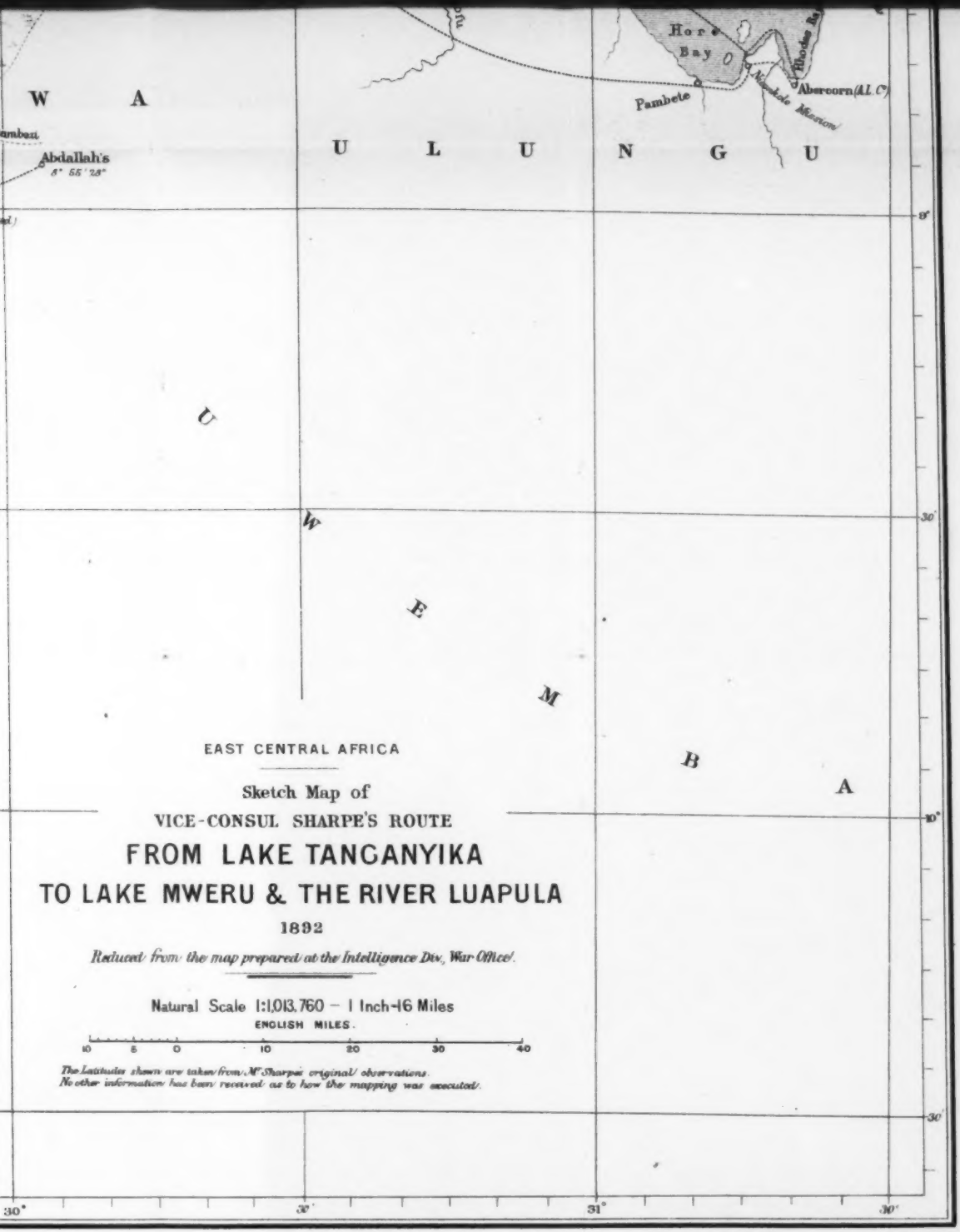
EAST CENTRAL AFRICA

Sketch Map of

VICE-CONSUL SHARPE'S ROUTE

FROM LAKE TANGANYIKA

Rhodesia Station
Salt Mputa
Cliffs 100 to 200 feet
Small Villages and Gardens of cassava
Low Cliffs
L A K E M W E R U
Murphy Delta
R. Kalongwisi
Low and Marshy
Low Cliffs
Kilwa I.
Red Cliffs
Rocks (Roche Station)
Shallows, reeds and floating weed
Village
Undulating Wooded Country
M a r s h e s
Many Elephants
Mofwe Lagoon
Original shore
R. Mbereto
Village
(Refugees from Marungu)
Mission
(Home of Lagoon)
Pools
KAZEMBE
Bimbe Lagoon
Plains
R. Luapula
Village 10°4'1"
Undulating Country
Villages
R. Ruku (Kalungu)
Wide Plain
Red Clay Cliffs
Gentle Hill (Wooded)
R. Bua
Johnston Falls
Rapids and Rocks
Dry forested Country
Four days to Mwanga (high range plains)
and one (or two) more to
(spoken of as the Mweru
I T A
Island
Open Water
R. Mofwe
R. Mwaru
Nsama (Abercrorn)
8° 59'35"
L U N D A
9°
10°
30°
28°
30°
Published by the Royal G



EAST CENTRAL AFRICA

Sketch Map of

VICE-CONSUL SHARPE'S ROUTE

FROM LAKE TANGANYIKA TO LAKE MWERU & THE RIVER LUAPULA

1892

Reduced from the map prepared at the Intelligence Div, War Office.

Natural Scale 1:1,013,760 – 1 Inch=16 Miles

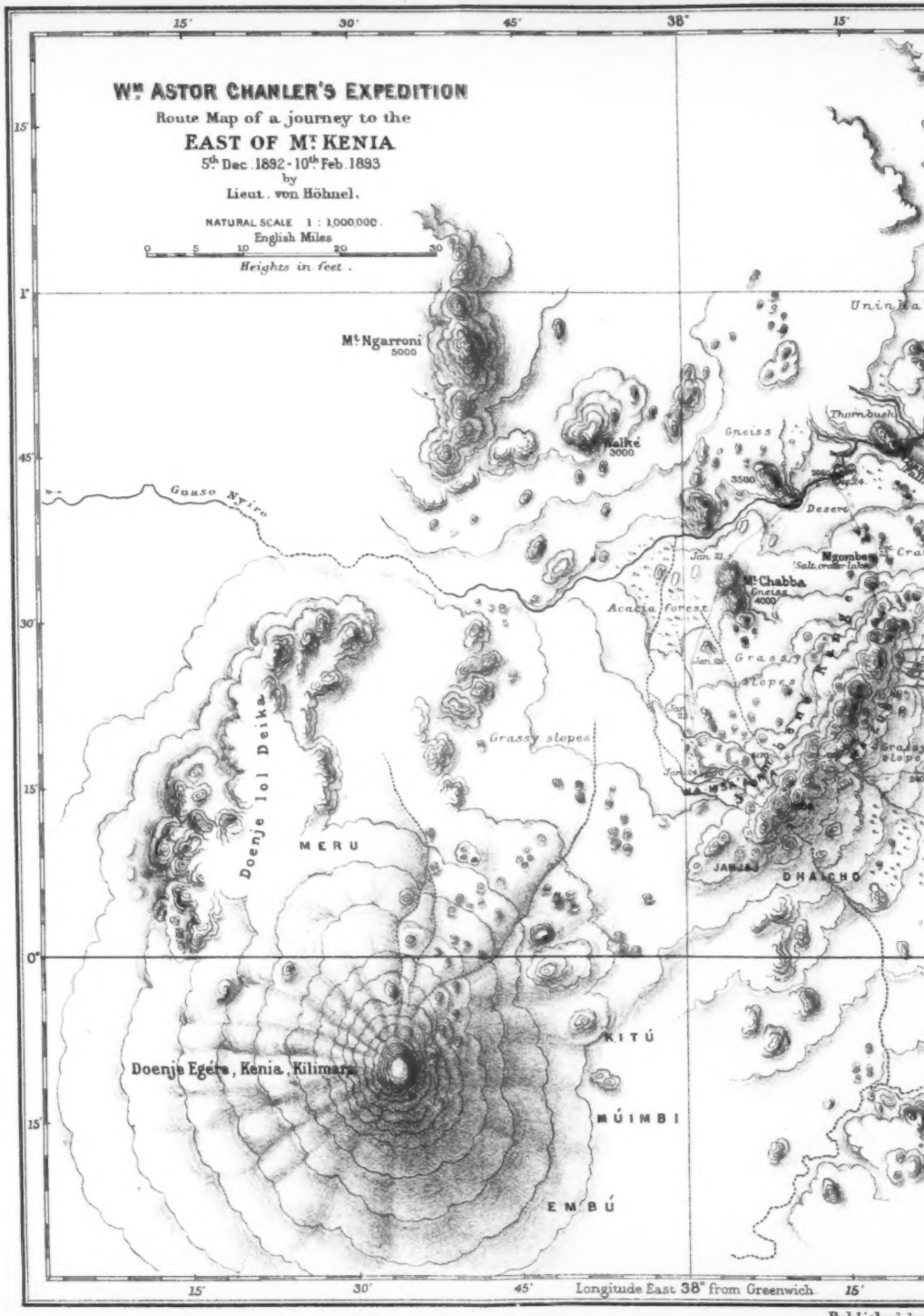
ENGLISH MILES.

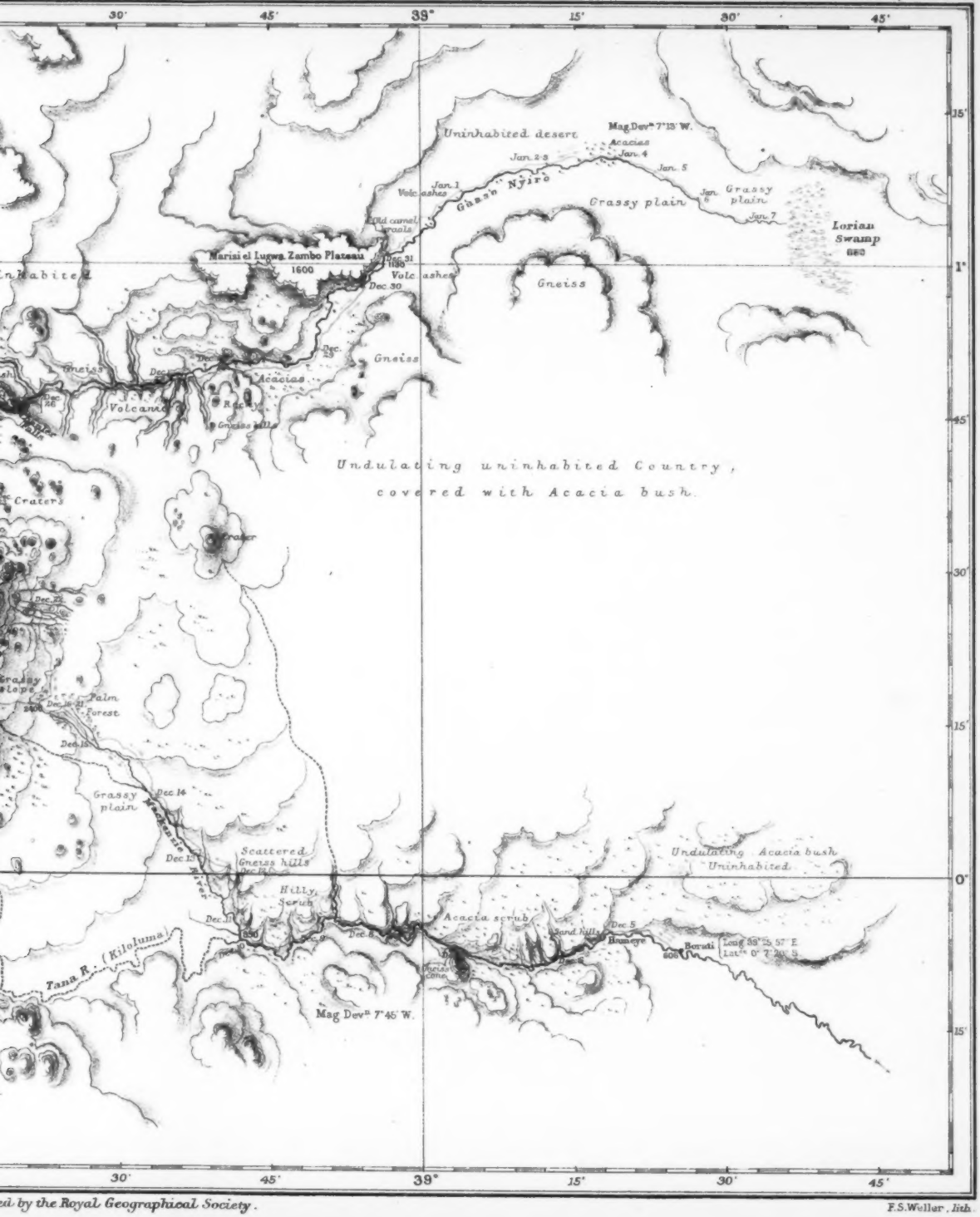
10 5 0 10 20 30 40

The Latitudes shown are taken from Mr Sharpe's original observations. No other information has been received as to how the mapping was executed.

Royal Geographical Society

Turner & Shawe, 43 Brewer Street, London, W.


Wm ASTOR CHANLER'S EXPEDITION
Route Map of a journey to the
EAST OF Mt KENIA
5th Dec. 1892 - 10th Feb. 1893
by
Lieut. von Höhnel.
NATURAL SCALE 1 : 1,000,000.
English Miles
0 5 10 20 30
Heights in feet.
15' 30' 45' 38° 15'
1°
45'
30'
15'
0°
15'
Mt Ngarroni
5000
Kalké
3000
Guaso Nyiro
Gneiss
3500
Desert
Mgombe
Salt crater lakes
Mt Chabba
Gneiss
4000
Acacia forest
Grassy slopes
Grassy slopes
Doenje lol Deika
MERU
Grassy slopes
JANJAS
DHAICHO
KITÚ
Doenje Egére, Kenia, Kilimaro
MÚIMBI
EMBÚ
Longitude East 38° from Greenwich.
Published by



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F.S.Weller, lith.

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